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NAME OF AUTHOR: Dorothy Mae Ryan

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AN EVALUATION MODEL FOR THE NATIONAL CERTIFICATION  
PROGRAM FOR MEDICAL LABORATORY TECHNOLOGISTS  
IN CANADA

by



DOROTHY MAE RYAN

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH  
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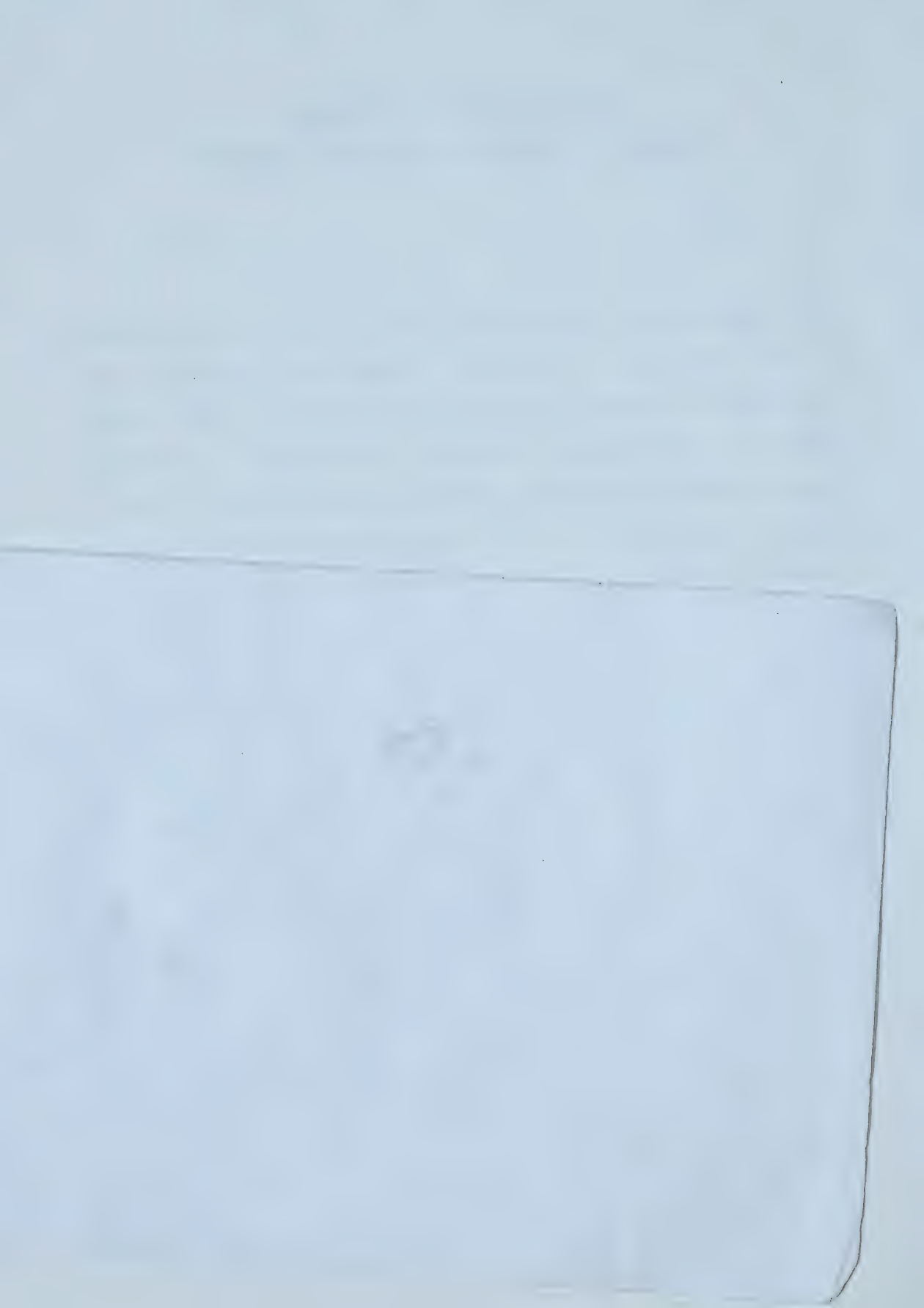
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THE UNIVERSITY OF ALBERTA  
FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "An Evaluation Model for the National Certification Program for Medical Laboratory Technologists in Canada", submitted by Dorothy Mae Ryan in partial fulfilment of the requirements for the degree of Master of Education in Vocational Education.





## ABSTRACT

This study was proposed to establish an acceptable evaluation model for the national certification program in medical laboratory technology in Canada. This program, under the auspices of the Canadian Society of Laboratory Technologists (C.S.L.T.), has been in existence for nearly fifty years but has never undergone a formalized evaluation process. With the tremendous advancements continually being made in the fields of medicine, science and technology, the C.S.L.T. recognized an urgent call to evaluate its program in the light of the needs of the graduate and the prospective employer.

A detailed review of the various models of program evaluation and evaluation instruments was conducted. From this review, a comprehensive evaluation model was formulated and designed. This model accounted for all components of the program through the survey of the heads of training programs in Canada (antecedents), the extensive review of the accreditation system in Canada (process), and the design of two questionnaires, a follow-up and an employer survey (product).

To ensure the validity and reliability of the follow-up and employer questionnaires, an extensive pretesting procedure was developed and administered.



In addition, "dummy" tables and graphs were set up to indicate how the returned data should be presented.

The final chapter contains a number of significant recommendations to assist the C.S.L.T. in revising/restructuring its certification program and Syllabus of Studies. It also outlines a number of future studies that should be considered in conjunction with these revisions.





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## CHAPTER ONE

### INTRODUCTION

Evaluation of curricula and programs is rapidly emerging as a discipline in its own right and as a special area in the field of education. An increasing dissatisfaction with the limited results that the educational system seems to achieve has led to a demand for accountability and for reliable evidence of returns on societal investment by legislators and taxpayers.

At the same time, professional organizations involved in licensing/certification have recognized a similar need for accountability - not in response to educational systems, governments and taxpayers - but in response to very real obligations to the membership of the organization, the prospective employer, and the ever-changing needs of the growing fields of science, technology and medicine.

The Canadian Society of Laboratory Technologists (C.S.L.T.), cognizant of its vital role as part of the health care team, is one of the first nationally recognized health occupations in Canada to actively pursue this universal call for accountability through program evaluation.



This study represents the efforts to establish an acceptable model for program evaluation within the medical profession in general and within medical laboratory technology in particular. At the same time, it is recognized that the resultant model is not restrictive in its application and could be used as an evaluation model in any professional/technical program.





## STATEMENT OF THE PROBLEM

The Canadian Society of Laboratory Technologists (C.S.L.T.) is the official registry and certifying body for medical laboratory technologists in Canada.

An individual proceeding to certification with the C.S.L.T. must successfully complete an accredited training program based on the approved Syllabus of Studies (guidelines to certification). This Syllabus of Studies is revised periodically in response to the changing needs of the scientific, technological, and medical fields.

Since its inception nearly fifty years ago, this certification program has never undergone an extensive evaluation process. In addition, it is recognized that the Syllabus of Studies represents the **PERCEIVED NEEDS** of the student technologists (needs usually perceived by educators) without sufficient documented proof that these are the **ACTUAL NEEDS** of the new graduate and/or employer. Each Syllabus revision involves numerous expansions and additions without a corresponding number of deletions to the actual core content required for certification. This situation cannot continue without adverse effects to the student, to the existing training programs and to the national certification process itself.



Therefore, the basic problem to be considered in this study is the development of an appropriate procedure or model for the evaluation of the existing national certification program for medical laboratory technologists in Canada with special emphasis on the validity of the existing Syllabus of Studies. In this way, it can be determined if this program is meeting the actual needs of the medical profession, teaching institutions, employers, society as a whole and the new graduates in the field.



## PURPOSE OF THE STUDY

The purpose of the study is to review the various models and strategies of program evaluation generally used in the educational setting and to develop an appropriate model applicable to the existing national program for certification in medical laboratory technology in Canada.

The proposed model will account for all components of a program evaluation either in a documented narrative approach or in a detailed descriptive research fashion. In so doing, the model will document the existing methods for input, process, and product evaluation and will provide strategies for gathering additional information for a more detailed approach to input and product evaluation. This data will be gathered through a survey of heads of training programs, recent graduates, and prospective employers to assess the actual needs of the new graduates in the work place and the ability of the existing training programs to meet these needs.

The proposed model will seek to answer the following questions:

- 1) What are the actual competencies and essential skills required by the new graduate in the work place today?
- 2) Does the existing Syllabus of Studies (guidelines



for certification) reflect these actual needs and essential skills as seen by:

- a) a new graduate?
  - b) the prospective employer?
- 3) What changes (additions/deletions) to the training programs and Syllabus of Studies are necessary to respond to the growing complexity of the scientific and medical field?





## DELIMITATIONS

The development of a program evaluation model and the carrying out of this evaluation to validate fully all aspects of the national certification process for medical laboratory technologists in Canada is beyond the scope of any project or thesis.

Therefore, this study will limit itself to the development of an appropriate evaluation model and the design of survey instruments for the antecedent (inputs) and product (outputs) components only. The process (thruputs) evaluation by accreditation will be discussed merely in a narrative fashion.



## DEFINITION OF TERMS

### ACCREDITATION

Selden (1972) defines accreditation as "the process by which an agency or organization evaluates and recognizes a program of study as meeting certain predetermined qualifications or standards." (p. 54)

In this study, the accreditation of training programs in medical laboratory technology, held every five years under the auspices of the Canadian Medical Association and endorsed by the various allied health societies and associations, involves an external on-site visitation by a team of professional experts. This team, representing the various professional groups, observe the operations of the training institute and clinical facilities, measure such performance against the established set of standards/guidelines and make specific written recommendations for continuation, improvement, or termination of a particular training program.

### EVALUATION

Evaluation, used in the broadest sense, can be defined as a process of examining and collecting pertinent information on all components of a particular training program (inputs, thruputs, and outputs) in order to make knowledgeable decisions regarding the effectiveness of the



particular program to achieve its goals and objectives.

In this study, the author will be evaluating the national certification program for medical laboratory technologists in Canada. This process will include all components in the program with special emphasis on the antecedent and outcome components.

#### CERTIFICATION

Certification is referred to as the process by which a non-governmental agency or association grants recognition to an individual who has met certain predetermined qualifications specified by that agency or association.

In this study, the author will be considering initial certification at the technologist level through the Canadian Society of Laboratory Technologists. The specific qualifications required for such certification include:

- a) graduation from an accredited training program
- b) completion of a specific in-service training component in an approved clinical laboratory.
- c) acceptable performance on the initial certification examinations

#### FOLLOW-UP STUDY

A follow-up study through a mail survey is a specific instrument used to evaluate the product



(graduates) of a particular training program, to gain input for program planning and improvement, and to determine the adequacy of the particular training program in preparing its graduates for job entry.

#### REGISTERED TECHNOLOGIST

For the purpose of this study, a registered technologist is any individual who has attained initial certification (general or subject) with the C.S.L.T. and who has maintained annual registration with the Society.

#### SYLLABUS OF STUDIES

A Syllabus of Studies is a point of reference or a guideline which sets the pattern for curriculum development and outlines, in behavioural terms, exactly what the student is expected to learn during the training program.

As stated in the preamble of the 1981 Syllabus of Studies, the C.S.L.T. Syllabus is to be viewed as "a guide for those intending to write the initial certification (R.T.) examinations and for all individuals responsible for the education and training of technologists preparing to write these examinations."

#### DIDACTIC PHASE

This represents the first phase in the two phase formal approach to the training of medical laboratory technolo-





gists in Canada. Consisting of 1-2 years in length, the didactic phase concentrates on the theoretical knowledge required in the five major disciplines (clinical chemistry, hematology, microbiology, histotechnology and immunochemistry), as well as in the introductory basic sciences.

#### CLINICAL PHASE

The second phase of the program is a one year clinical phase in an approved training laboratory with emphasis on the practical application of the basic sciences and technical component taught in the didactic phase.



## ASSUMPTIONS

In the design of this study, the following basic assumptions were made:

1. the survey questionnaires were valid instruments for the collection of desired data.
2. the questions conveyed the objectives of the study according to the intent of the author.
3. the returned questionnaires were interpreted according to the intent of the respondent.
4. the respondents were representative of the total number of graduates.



## IMPORTANCE OF THE STUDY

### A. BACKGROUND INFORMATION

The history of medical laboratory technology reaches back as far as the history of medicine itself. As Gibson (1964) relates, Valeris Cordus was simply called a laboratory worker even though his method of ether preparation in 1540 proved to be the basis of ether inhalation anesthesia. William Perkins, another "laboratory worker" in England, discovered methylene blue which unraveled the histopathology of the nervous system. Records show that individuals employed in laboratories throughout the early centuries were known as laboratory workers even though their discoveries contributed greatly to the future of modern medicine and the welfare of mankind.

Before the beginning of the twentieth century, formal training of medical laboratory personnel was virtually non-existent. Most laboratorians possessed very little education and were simply shown how to perform a few simple tests. The profession of medical laboratory technology had its genesis in the early part of the twentieth century when pathologists began to train assistants to perform rudimentary tasks in the analysis of body fluids and tissues as well as in autopsy work. Such training was done in the hospital laboratories and focused on practical



application rather than on theoretical knowledge. Ruth Hovde (1962) contends that the field of medical technology actually developed out of the need of the medical profession to provide more service in one of the areas within the practice of modern medicine, namely, the clinical laboratory.

## B. EVOLUTION OF MEDICAL LABORATORY TECHNOLOGY TRAINING IN CANADA

On May 20th, 1937, the Canadian Society of Laboratory Technologists (C.S.L.T.) was incorporated under Dominion Charter by authority of the Companies Act of Ontario. Since its inception, its major interest has been the training and national certification of medical laboratory technologists in Canada and the continuance of high standards of practice in response to rapidly changing technology in health care.

In 1940, the Canadian Medical Association appointed the C.S.L.T. as the official registry and certifying body for medical laboratory technologists in Canada. By so doing, the C.M.A. recognized that membership in the C.S.L.T. would itself be a warrant of satisfactory training experience and professional competence.

Prior to 1937, training in medical laboratory technology was done "on-the-job", and the only examination/certi-





fication available in North America was through the American Society of Clinical Pathologists (A.S.C.P.). With the formation of the new Canadian Society (C.S.L.T.), and in conjunction with the Canadian Medical Association, a conjoint program of formal and regulated courses of instruction towards Canadian certification was established.

Up until the 1960's, training was formalized within the hospital setting with each hospital meeting the standards of curriculum and practice as outlined by the professional organization (C.S.L.T.). As Atkinson (1972) confirms, this apprenticeship system of training left much to be desired. The information that rubbed off onto the student or was picked up "by osmosis" in the normal course of events of "just being in the lab", was not the type of instruction or background knowledge needed to meet the challenges of the expanding technological and scientific field. However, as pointed out by Hovde (1962), such a system seemed appropriate at a time when most "experts" believed that methodology would not change appreciably during the working life of the individual technologist.

However, the overwhelming demands and developments in all aspects of technology, medicine and science completely revolutionized overnight the professional activities of the medical laboratory technologist in Canada. Automation was in - manual methods were out. As Hovde (1962) aptly put



it: "the day of the hand-maiden was over!". The end result was the recognition of the inability of clinical facilities in most hospitals to cope with the necessary didactic training to meet these changes. At the same time, political, educational and economic circumstances led to the evolution of new post-secondary institutions, community colleges and technical/vocational institutes. Therefore, it came as no big surprise when the traditional on-the-job training was transferred to these provincially centralized educational institutions who were heralded as being better equipped to handle the complex and sophisticated technologies within the health care field.

This transfer of medical laboratory technology training to the post-secondary institutions resulted in major changes in the existing program leading to initial certification. Most training programs, with the exception of university programs, consist of two or three years of theoretical and practical training depending on whether the entrance requirement to the institution was a junior or senior matriculation level. If entrance is a junior matriculation level, the first year at the college is essentially senior matriculation equivalent with some orientation towards the specified allied health sciences. The second year is devoted to the theory of the various clinical disciplines with some laboratory sessions to develop basic competencies. If entrance to the program



requires senior matriculation level, the year at the institution is devoted to the theoretical knowledge of medical laboratory technology.

Whether the institution offers a two- or three-year program, each program is divided into two distinct phases: the DIDACTIC PHASE within the educational institute and the CLINICAL (INTERNSHIP) PHASE within the clinical facility, usually a clinical laboratory in a general hospital. These two phases differ considerably both in approach and in control:

#### 1. DIDACTIC PHASE

As stated earlier, the didactic phase within the post-secondary institution concentrates on training the student in the theoretical knowledge necessary for skill development, and in most cases, exposure to the basic level of skill acquisition. Since most programs are designed towards the initial certification with the C.S.L.T., the five major disciplines are included in the didactic training, namely, clinical chemistry, hematology, microbiology, histotechnology, and immunohematology. Specific courses are also established in general and organic chemistry, anatomy and physiology, and laboratory instrumentation and orientation. In this way, the training at the R.T. (General) level adheres to



the "cluster concept". An individual is initially prepared to enter gainful employment in a number of specialized areas, thus permitting a high degree of mobility and flexibility in the future.

## 2. CLINICAL (INTERNSHIP) PHASE

In the one-year clinical phase, the emphasis is on the practical application of the basic principles learned in the didactic phase and on the development of manual dexterity in working with laboratory specimens. This is accomplished through an integration of tutorial sessions and "hands-on" experience through each of the laboratory departments. The importance of this clinical component in the overall picture is summed up in the words of Rosarii (1970):

The internship (clinical education) phase of health science programs is the "heart" of the student's educational experience. Under the tutelage of the hospital or other health facility sponsor, the student has the opportunity to learn first-hand the internal operations of his or her particular field of study. The student will furthermore, be able to apply many of the skills and concepts he/she has learned in class in the clinical situation. The combination of theoretical knowledge obtained in the classroom environment will enable the student to obtain the well-rounded background so urgently needed in our contemporary society (p. 2055).

Thus, neither the classroom nor the clinical setting provides all the new materials needed for the end product; some experiences take place primarily in





one setting while others chiefly occur in the other.

Therefore, joint consultation between institution and clinical facility is critical to the success of the program. In reality, as pointed out by Atkinson (1972), a better approach would be a comprehensive program which is fully integrated both in the training centre and in the clinical laboratory.

Upon the successful completion of the program, the student is eligible to challenge the Initial Certification examinations set by the C.S.L.T. and, if successful, receives a certificate as an R.T. or registered technologist.

### C. EVOLUTION OF THE SYLLABUS OF STUDIES

As the certifying body for medical laboratory technology in Canada, the C.S.L.T. must ensure that adequate standards of practice and accredited training facilities are maintained throughout the country. To facilitate this onerous task, a Syllabus of Studies is approved and periodically revised so that every technical institute/college/university responsible for the training of medical laboratory technologists will have similar aims and objectives when developing its own curriculum. It should be noted, as pointed out by Atkinson (1972), that the Syllabus is NOT meant to be a curriculum telling the various institutes



how and what to teach but a general outline of topics and headings to be covered to ensure adequate preparation for initial certification examinations.

### Syllabus of Studies: 1941

The first Syllabus of Studies of the C.S.L.T. was completed in 1941 and, as stated on its covering page, dealt briefly with "the scope of work which should be covered by an applicant for registration as a General or Specializing Technician". This Syllabus was divided into six major headings - Bacteriology, Biochemistry, Hematology, Serology, Parasitology and Histology - and covered two full pages. Its content reflected a field in the embryonic stage of life trying to establish itself without the advantage of formal structures and set guidelines. Within its limited scope of practice, its purpose was simply stated as:

1. "a thorough knowledge of" ...a number of stains, techniques, terminology and methods
2. "principles, normal values and methods of performing" ... a number of tests and procedures

Today, in the vise-like grip of "objectives" - student performance objectives, general objectives, specific objectives, behavioral objectives, in-



structional objectives - educators would find the content and format of this first Syllabus totally unacceptable. However, at the time and with the limited facilities, equipment, and techniques available, it was totally acceptable and meaningful both to the student and to the instructor.

### Syllabus of Studies: 1957

In 1957, the Syllabus of Studies underwent another revision. This time, it reflected a more formal approach to the training of medical laboratory technologists and an understanding and appreciation of the complexity and diversity of this new era in the medical and scientific field. This Syllabus, consisting of sixteen pages and five major headings - General Knowledge, Histology, Bacteriology and Immunology, Clinical Chemistry, and Hematology - also included a list of reference books at the end of each major heading. Once again, we recognize the same vague statements found in the previous Syllabus:

1. "a basic knowledge of" ...morphology, staining, methods
2. "basic principles and methods for"...

For the first time, there is an initial emphasis on such general knowledge topics as: laboratory safety, care and maintenance of laboratory equip-



ment, specimen collection, and laboratory records.

### Syllabus of Studies: 1967

The first major breakthrough in the evolution of the Syllabus of Studies came with the revision of 1967. As stated in the preamble, this revision recognized "the need for higher standards of technological knowledge and performance and the advances being made in training". It goes without saying that the changes in program delivery and transfer to approved centres outlined previously, were reflected in this new Syllabus.

Now, with the academic environment of college-based training programs, a more comprehensive and detailed Syllabus was required. The result was a Syllabus of thirty pages with six major headings - General Knowledge, Histology, Clinical Microbiology, Clinical Chemistry, Hematology and Blood Bank Technology - and an extensive list of references. The name change to "clinical microbiology" recognized the expansion of study into areas other than bacteriology such as mycology, virology and parasitology. The further recognition of blood bank technology as a separate entity was in keeping with the rapid advances in blood group systems and blood transfusion procedures. In addition, greater em-





phasis was placed on instrumentation, laboratory safety, anatomy and physiology, quality control, and laboratory records.

### Syllabus of Studies: 1973

Under the auspices of the C.S.L.T. Certification Board responsible for all matters pertaining to the standards, method of training and certification, the 1973 revision of the Syllabus of Studies reflected a modified form of behavioral objectives. The Syllabus grew in proportion to the numerous technological advances witnessed in the late 60's and early 70's: it consisted of 36 pages, five major subject headings by discipline - clinical chemistry, clinical microbiology, immunohematology (blood banking), hematology and histotechnology (histology) - as well as an itemized citing of Syllabus resource material and additional references.

For the first time, the Syllabus adequately integrated the total training, the didactic and clinical phase of the training program, stated in very specific terms the core content to be tested at the end of the training, and referenced the sections under each heading so that both the instructor and student would know the source of the material to



be demonstrated.

The disappearance of the general knowledge section recognized the need for this basic introductory knowledge within each of the specific disciplines rather than as a separate section without relationship to any specific area.

### **Syllabus of Studies: 1981**

The most recent Syllabus revision clearly states the purpose of the Syllabus: a guide for those intending to write the R.T. examinations and for those responsible for the training of these technologists and the depth of knowledge required of a newly registered graduate. This newest Syllabus is divided into six headings and consists of 43 pages.

For the first time, the Syllabus outlines the general objectives of the total training program and of the new graduate at the R.T. level. These objectives state that the new graduate should:

- a) Be able to perform basic clinical procedures within defined limits of accuracy.
- b) Possess sufficient theoretical knowledge to learn to perform more complex procedures under supervision of personnel accountable for those procedures.
- c) Be able to recognize and identify anomalous results due to technical errors, and common equipment malfunction.
- d) Be able, under supervision, to undertake corrective measures required for (c) above.
- e) Be able to assist in the implementation and



- development of new techniques or improvements to existing techniques.
- f) Be able to recognize when the results of a laboratory procedure fall outside clinical established normal values, and to initiate appropriate action which may include reporting through established channels and carrying out additional related tests within established guidelines.
  - g) Be responsible for initiating ordering of supplies.
  - h) Be responsible for collating statistical information pertinent to assigned duties.
  - i) Ensure that the laboratory is kept safe, clean and orderly.
  - j) Ensure that laboratory equipment used in performing tests referred to in this Syllabus, is kept safe, clean, and operational.
  - k) Recognize and respect the confidentiality of patient information.
  - l) Be able to communicate effectively with patients and hospital personnel.

(Preamble, 1981 Syllabus of Studies)

This brief account of the evolution of the C.S.L.T. and its Syllabus of Studies clearly indicates the cumulative increase in core material over the past 40 years as well as the technological advances in automation, sophisticated equipment and testing procedure. It also highlights the primary concerns that initiated this study:

1. what essential core body of knowledge is required of the new C.S.L.T. graduate by the work place?
2. can this body of knowledge continue to be learned adequately in a 20-24 month period?
3. what body of knowledge should be included



in the general initial certificate and what body of knowledge should be reserved for the speciality and advanced level of certification?

4. what skills are best learned in the clinical laboratory environment?
5. is the existing process of external accreditation appropriate and sufficient to ensure national standards?
6. does the existing Syllabus of Studies (guidelines for certification) reflect these actual needs and essential skills as seen by:
  - a) a new graduate?
  - b) the prospective employer?
7. what changes (additions/deletions) to the training programs and Syllabus of Studies are necessary to respond to the growing complexity of the scientific and medical fields?





## CHAPTER TWO

### REVIEW OF RELATED LITERATURE

The review of related literature includes two distinct and unrelated sections:

#### Section One:

In order to gain the necessary understanding and appreciation of program evaluation and its growing importance in education, a comprehensive study of the definition, history, and various models of program evaluation was performed.

#### Section Two:

A second literature search included a review of the major evaluation instruments - interviews, questionnaires and pilot studies. This knowledge proved invaluable in the setting up of the surveys and follow-up studies.

### Program Evaluation

The process of evaluation is not new to man. As a rational being, man has always been intimately involved in assessing, appraising, judging, and valuing everything around him. The history of educational and program evalu-



ation is relatively new, dating back to the early 1900's with the advent of the accreditation movement or evaluation by external audit. This team evaluation approach described by Wentling and Lawson (1975), saw a group of experts descend upon a school for a period of three or four days to examine the facilities and materials used, to observe the actual teaching process in the classroom, and to discuss the instructional/learning process with the teachers and pupils. After this on-site examination, the team wrote a detailed report of their findings describing the observed situation and making recommendations for improvement and change.

Under the tutelage of Ralph Tyler, educational evaluation in the 1930's focused on goals and objectives, measurement by testing student outcomes. In this process, program evaluation became the assessment of student attainment of instructional objectives specified by the program developers.

The first major revolution in program evaluation came in the 1960's. During this period, the educational community witnessed the requirement of third party evaluation of federally-funded projects in the United States and Canada. This requirement provided the **NEED AND FUNDS** for the creation and the development of numerous



MODELS of evaluation. At the same time, there was a growing awareness that attainment of specific objectives was only ONE dimension of program evaluation. Instructors' performance, learning experiences, worthiness of the objectives themselves, and the unintended outcomes must also be considered within the evaluation process.

The evolution of program evaluation as cited above and the various models or strategies to such evaluations to be discussed later, compel us to ask the basic question: WHAT IS PROGRAM EVALUATION? Tyler (1942) would simply state that evaluation is the process of determining whether objectives have been achieved. Hammond (1973) echoes this belief as he sees program evaluation as the determination of the effectiveness of a program to achieve the intended goals and objectives. Scriven (1967) and Worthen and Sanders (1973) maintain that an evaluation is to determine the worth, value or merit of a thing. Franklin and Thrasher (1976) go beyond the narrow definition of program evaluation as the evaluation of outcomes related to the achievement of program objectives to the analysis of program inputs as well as outcomes.

Many well-known exponents of program evaluation see its primary role as providing relevant information and informed judgments to the key decision-makers. For Alkin (1972),



evaluation is a process of ascertaining the decision areas of concern, selecting appropriate information, and collecting/analyzing the information to help the decision-makers in selecting reasonable alternatives. Stufflebeam (1972) presents program evaluation as a process of delineating, collecting, and providing information useful in judging decision alternatives.

Wright (1970) contends that the major differences among most definitions and models of program evaluation are primarily those of terminology, emphasis/biases, and data recording procedures. This statement may be an oversimplification of a complex process, but it does illustrate the similarities and commonalities in all the traditional models:

1. do the actual learning experiences produce the desired results?
2. how effective is the program and the instruments used in the program?
3. what are the strengths and weaknesses of the program?
4. what changes/improvements should be made in the program?





## Tyler's Goal Attainment Model

Although the author does not agree with Tyler's stress on stating objectives behaviourally and on relying on achievement tests in program evaluation, it is important to recognize his influence in this area not only in the 1930's but also in our present day with the resurgent emphasis on accountability and testing.

For Tyler (1942), program evaluation contains six important steps:

1. the formulation of broad goals and objectives
2. the classification of these objectives into major types
3. the descriptions of these objectives in behavioural terms
4. the specifications of student learning experiences for the achievement of the objectives
5. the selection of appropriate means of measuring the objectives
6. the actual measurement of the achievement of the objectives
7. the comparison of actual achievement with previously established objectives.

As can be seen, the evaluation is essentially "objectives-oriented". If the goals are attained, the program is considered successful; if the goals are not attained,



the program is inadequate. Atkin (1973) would object to such an evaluation because it does not question the worthiness or value of the objectives themselves, it assumes that we can readily identify the educational objectives for which we can strive and that all important outcomes can be stated in behavioural terms. He believes that the program regresses towards the objectives reflected by the test items because the teacher limits the range of his/her exploration and innovation.

### Stufflebeam's CIPP Model

Stufflebeam (1966) sees the role of evaluation as a continuing process, providing information to decision-makers. His actual model is composed of four types or classes of decisions and four corresponding evaluations:

#### 1. Context Evaluation:

Context evaluation is usually employed in the planning stage when a program is first being conceived. These planning decisions will involve choices regarding program objectives based on recognized needs (student needs, employer needs, and community needs).

#### 2. Input Evaluation:

Structuring decisions involve the choosing of numerous alternatives to achieve the



desired objectives. Therefore, input evaluation is the development of plans for achieving the goals and objectives based on an assessment of available facilities, staff, budget, materials and procedural designs, and resources.

### 3. Process Evaluation:

Stufflebeam (1966) felt that periodic feedback to the decision-makers would provide the necessary information for implementation of decisions regarding:

- a) deviations of the program from its original design
- b) implementation problem areas that need adjustment
- c) interpersonal relationship problems among staff and students
- d) adequacy of the resources, physical facilities, staff, and time schedules
- e) necessary improvement to the ongoing program
- f) positive and negative outcomes of the program

Therefore, the primary goal of process evaluation is to monitor on a continuous basis the program as it is being implemented.



#### 4. Product Evaluation:

Product evaluation considers the overall effectiveness of a program by determining the degree to which the intended objectives and goals have been met and to relate this to context, input and process in the measurement and interpretation of the outcome.

Stufflebeam's model is appealing to the author as a comprehensive and realistic approach to the evaluation of occupational training programs. This model not only attempts to define and measure outcomes (the extent to which objectives are achieved) but also attempts to explain outcomes (the functional relationships between outcomes and process variables).

#### Evaluation by Scriven

Scriven (1967), one of the founding fathers of program evaluation, has presented us with many "approaches" to achieve the major purpose of any educational evaluation, namely, the establishment and justification of the merit, worth and value of a program.

In following through on the above purpose, Scriven avoids a personal model PER SE and merely highlights the various evaluations that should be considered:





### 1. **Formative/Summative Evaluation:**

Formative or internal evaluation is seen as part of the curriculum development process in which constant feedback would result in continual improvement of the program. Summative evaluation, done by an external evaluator, is a means of assessing the merit of curricula once they have been developed and used. Such an evaluation would determine whether or not objectives have been met.

### 2. **Intrinsic/Pay-off Evaluation:**

Subsequently, Scriven describes an alternative approach to evaluation, namely, intrinsic/pay-off evaluation. This approach appears to be a further delineation of the previous formative/summative evaluation procedure.

Intrinsic or instrumental evaluation is an appraisal of the teaching instrument or process itself: content, goals, grading procedures and teaching attitudes. Pay-off or consequential evaluation looks at the end product and attempts to judge the effect of the learning environment on the student.



As Stufflebeam (1974) points out, Scriven felt that all evaluations must judge both the goals and the results in order to properly assess the overall merit of a program. Therefore, product criteria cannot be evaluated in isolation but must be seen in relationship to the process or instrument used.

### 3. Goal-free Evaluation (G.F.E.):

At a later date, Scriven (1972) developed his goal-free evaluation approach. Although it is not directly stated, the author feels that this idea evolved because of Scriven's strong emphasis on the true and appropriate role of the evaluator. He believes that the evaluator should not just present an evaluation report - pertinent information for scrutiny - but should present some objective assessment of the merit of the program that could be subsequently used in formal judgment by decision-makers. In so doing, the emphasis on evaluation must be on ACTUAL effects, not INTENDED effects. Thus, the goal-free evaluation approach was seen by Scriven as the answer.



Scriven is persuasive in his argument that the alleged goals are often very different from the real goals and that it is essential to avoid tunnel vision through a goal-free evaluation approach. In addition, the GFE is less influenced by the "powers that be" in that it is not attempting to prove/ disprove any objectives or goals but merely observing the "that which is".

Other evaluators such as Stufflebeam, Alkin and Popham have been overly kind in their criticism of the goal-free evaluation approach by Scriven. Stufflebeam (1972) sees GFE as a "methodological strategy that can be used to supplement others (models of evaluation)" (p. 4). However, it should not be approved as an alternative model of evaluation since evaluation means judgments based on standards or goals. Alkin (1972) maintains that the GFE approach DOES indeed recognize goals, but the goals are broader than the specific goals of the program under consideration. Popham (1972) sees the contribution of the GFE approach as a warning to evaluators to assess a program on the basis of all important effects, not just goals and objectives.



## Stake's Countenance Model

MacKay and Maquire (1971) classify Stake's model as an electric or industrial model that focuses on the collection of data that will not only answer questions regarding the existing program but that will also pose additional questions that should be seriously considered in the determination of the worth and value of any particular program. In this way, this author senses the completeness of the model with its emphasis on the unintended as well as intended outcomes [referred to by Stake (1973) as the "side effects or bonuses"], the antecedent conditions, and the instructional transactions.

Although Stake's model appears somewhat complex, the rationale behind its evolution is totally logical and thorough. In the first three cells as outline in Figure 1, the intentions of the program are spelled out:

**Intended antecedents:** Antecedents are those conditions that exist prior to the teaching/learning experience that may relate to or affect the outcome such as the facilities, teachers, and students.

**Intended transactions:** Transactions are the countless encounters and activities of the student during desired outcomes. This would include the



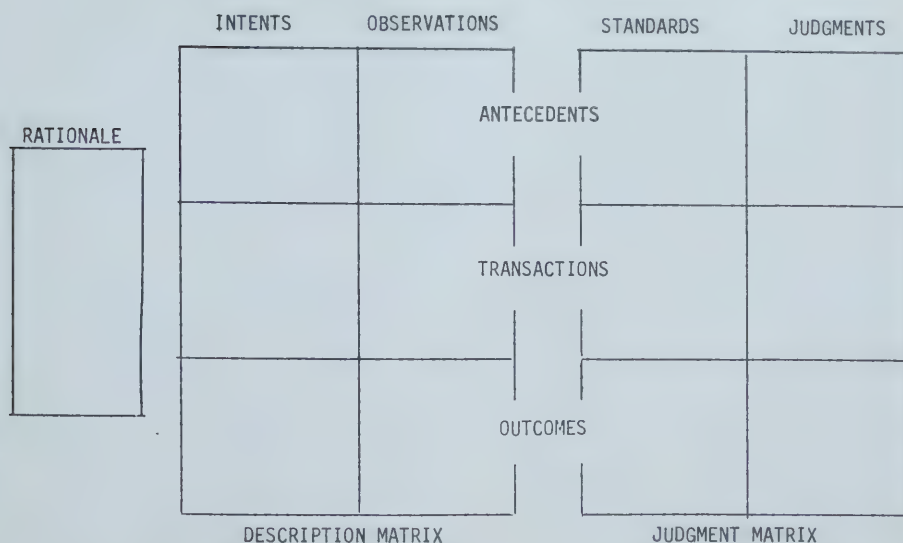


educational climate and environment, the actual learning activities and experiences as well as psychomotor, attitudinal, and motivational development.

**Intended outcomes:** Outcomes are the consequences or results of the educational process and the measurement of the impact of instruction. Obviously, such outcomes are closely tied to the specific goals and objectives of the program as well as the intended transactions.

Figure 1

### Robert Stake's Countenance Model





In the second group of cells, Stake considers what actually happens in each of these components:

**Observed antecedents:** This involves the actual description of what is observed regarding the facilities (classrooms, laboratories, study areas), the teachers (qualifications, interests, teaching methods), and the student (home environment, parents' expectations, cultural and social activities).

**Observed transactions:** What actually occurs in the day-to-day instructional system: student-teacher relationship, classroom activities, allotment of time for each activity, student-student interaction, evaluation process.

**Observed outcomes:** What are the immediate observable outcomes (at the end of the year) and the long range outcomes (at a later date).

Stake (1973) stresses that a complete description of all intended and observed components of a program is essential in order to make any evaluative judgments. Otherwise, judgment statements are made without sufficient documentation and defense. After the description matrix has been developed, it is possible to evaluate the



"intended" and "actual" goals, means and results for congruency/discrepancy, and contingency/causal effect. In addition, this information would also allow judgmental comparisons against absolute standards and/or other similar programs.

### **Provus' Discrepancy Model**

Malcolm Provus (1971) contends that the purpose of evaluation is to determine whether to improve, maintain, or terminate a given program. Therefore, the evaluation process requires the following steps:

1. the comparison between the existing program and some agreed-upon program standards
2. the determination of a difference or discrepancy between some aspect of the existing program and the set standards governing that aspect of the program
3. the use of this discrepancy information by decision-makers as a rational basis for program adjustments or termination.

In order to acquire the necessary information to reach the above decisions, the following development stages of program evaluation must be followed in the Discrepancy Model:

1. **Program Definition:**

A detailed description of the program as



perceived by the staff members is obtained through a brainstorming technique. This information about objectives, staff, students, and facilities and instructional activities used to reach the objectives forms the standard against which the program will be evaluated.

## 2. Program Installation:

The evaluators observe the actual process of student-teacher activity so that they can compare this reality with appropriate activity program standards developed in stage 1. Therefore, the purpose of this stage is to determine the extent to which the program has been installed as designed.

## 3. Program Process:

The evaluator collects data indicating how and/or if student behaviour is changing as predicted by the enabling objectives. It is essential to appraise learning activities for their effectiveness.

## 4. Program Products:

The evaluator seeks to answer the basic question: "has the program achieved its





terminal objectives?" This is done by comparing the reality of the terminal products with the specified standard terminal products.

The strength of Provus' model lies in the involvement of the program staff in setting objectives and standards, and the collection of adequate data by which to measure the value and merit of the particular program. However, the development of the program definition/design criteria that forms the basis for the entire evaluation is subject to assumptions and perceptions that could prove faulty or misleading. In addition, this model seems to exclude a mechanism for continuous monitoring of the program.

### Accreditation Model

Pennell, Proffitt and Hatch (1971) describe the evolution of the accreditation approach to program evaluation in the United States. As it was conceived in the mid-1800's, it was a voluntary mechanism of approval of specific educational programs by educators and respective professions. As each professional organization was formed, it regulated the program of study in its field and established standards of practice for its members. It is interesting to note that accreditation of health educational programs in medical laboratory technology began between 1930 and 1960 in both Canada and the United States.



The author considers accreditation an appropriate program evaluation model, particularly as it applies to national health educational programs. The purposes of such accreditation can be stated as:

1. assisting prospective students in identifying approved programs
2. assisting institutions in determining transfer credit from other institutions
3. certifying that an institution has met established standards
4. establishing criteria and guidelines for professional certification
5. creating goals for self-improvement

In North America, two professional groups have undertaken accreditation of educational programs for multiple allied health occupations, namely, the Council on Medical Education of the American Medical Association and the Conjoint Committees on Accreditation of Educational Programs for Allied Health Disciplines of the Canadian Medical Association. In each case, an accreditation team, through an on-site visit, observes and evaluates the educational process for the purpose of providing suggestions for improvement.

Usually, accreditation occurs every three to five years by a team of professional experts representing a cross-



section of the specific educational and occupational areas. Prior to the on-site visit, each member of the accreditation team should be supplied with a description of the program to be evaluated, results of previous evaluations, demographic data related to the program, and a set of criterion questions that define exactly what is to be evaluated.

Wentling and Lawson (1975) maintain that a total program evaluation should include an assessment of the liaison between sending institutions and clinical facilities, philosophy of the program, goals and objectives, planning, administration, research and evaluation, learning resources, staffing, and physical facilities. In addition, curriculum evaluation in specific disciplines would include course objectives and their relationship to essential competencies, methodology, equipment, learning resources, student records, and evaluation process.

It should be emphasized that the accreditation team is expected to identify exemplary characteristics as well as deficient components of the program. Many evaluation teams overlook this responsibility and focus entirely on deficiencies. In addition, suggested solutions and remedies to the cited deficiencies should be considered an important part of the accreditation process.



Roemer (1974), quoting from a study of Accreditation of Selected Health Education Programs, identifies some major problems in accreditation:

**1. Accountability:**

It is felt that the accreditation process should be accountable not merely to the health professions but to a much broader audience including students, educational institutions, governments, potential employers, and the public-at-large.

**2. Structure of Accreditation Teams:**

Consideration should be given to lay representatives on such accreditation teams to ensure protection of the public.

**3. Financing of Accreditation:**

The cost of accreditation should be borne by the educational institutions and the health professional organization. In Canada, this financial arrangement has been established successfully.

**4. Research in Accreditation:**

Little research has been conducted in the field of accreditation. Research is urgently needed to determine the viability and





relevance of traditional guidelines for accrediting education programs.

#### 5. Relationship of Accreditation and Certification:

Certifying agencies normally require graduation from an accredited program in establishing eligibility to certification examinations. This link in the regulation of health care occupations points to a possible weakness in the overall system if either process is weakened.

#### Adversary Model

Although many recognized experts in program evaluation have written about the adversary model - some in glowing terms and others in not-so-glowing accounts - it is difficult to determine its founder and chief proponent.

Levine (1973) contends that informed human judgment is as effective as the pseudo-precise instruments/designs and the imperfect mathematical processes now in vogue in program evaluation. In his comparison of the scientific method and the adversary method, Levine (1974) goes further and questions the over-reliance on the experimental method wrought with serious problems in application over the adversary approach which appears more appropriate



especially in the area of psychology. Similarly, Wolf (1975) recognizes the potential power of the adversary model in the balanced presentation of human testimony and the objective human judgment subsequently rendered based on this evidence. This is in direct contrast to the existing quantification and technical analysis now in vogue within traditional approaches to program evaluation. Arnstein (1975) agrees that its major strength is in bringing a variety of facts and opinions together in a well-rounded and balanced manner. After their personal experience with the adversary model at the Counselling Centre of the University of Nebraska-Lincoln, Williams and Pinkney (1981) herald this evaluation strategy based on the judicial process as an effective alternative to standard evaluation models that fail to really affect decision-makers and/or programs. Kourilsky (1973) sees the adversary approach as an alternative to other evaluation models because unlike the traditional approach which she coined the "single recommendation approach" or expert advice approach, the adversary model presents a balanced representation of both sides of an evaluation issue.

Many writers are more guarded in their comments and proclamations regarding the adversary model. Thurston (1978) acknowledges a limited application of the adversary model in educational evaluation and sees its main contribution in the "open forum" style through which



arguments for and against are presented publicly. Popham and Carlson (1977) feel that the numerous deficiencies in the model renders it totally ineffectual and inapplicable for educational evaluation.

Although the above authors may not agree on the merits of the adversary model, they do agree on the actual procedure and characteristics of this novel approach. It emulates the legal or judicial process, trial by jury, complete with prosecutor (NEGATIVE EVALUATOR) and defense (AFFIRMATIVE EVALUATOR). It emphasizes confrontation, competition, sharpening of issues and objectivity in a forceful presentation of both sides of an issue.

In simplest terms, the adversary model is the presentation of oral arguments about a program by an ADVOCATE and ADVERSARY to a PANEL who then renders judgment based on the evidence heard. It provides for the structured consideration of alternative arguments and inferences which help to keep the evaluation honest and fair.

Thurston (1978), Kourilsky (1973), Wolf (1975), and Williams and Pinkney (1981) present a united front in reviewing the advantages and/or strengths of the adversary model. Briefly, they include:



1. When both sides of an issue are presented and aired, the decision-maker has a wider range and better quality of information on which to base decisions. Therefore, this should lead to more rational decisions regarding the continuance/discontinuance of a program.
2. The issue and exploration of human testimony and the recognition of the value of human intelligence making sense out of what it observes, makes the adversary model a true evaluation model.
3. The adversary model diminishes the possibility of bias and the "yes man syndrome" in which evaluators consciously or unconsciously manipulate their findings to agree with the pre-conceived ideas and personal biases of the decision-makers.
4. This model, through its "open forum" style, effectively responds to the need for public accountability and gives the program higher profile and credibility within the community.

Popham and Carlson (1977) seem ruthless in their criticism of the adversary model. However, Benson and Hiscox (1980) would agree with their conclusions. Both parties recognize the following deficiencies in such an approach:





1. There will always be some disparity in the skills of the two adversarial teams, and this disparity could lead to erroneous decisions by the panel.
2. The adversary model should only be used when a clear-cut binary choice can be made because the judicial system does not lend itself to intermediate measures.
3. An adversary evaluation is twice as expensive as a conventional evaluation.

However, Thurston (1978) would argue that the above concerns are greatly overstated. Such charges of excessive costs and possible manipulation of results are not unique to the adversary model. In addition, the adversary model does not necessarily mean a yes or no conclusion. The panel could render several decisions on various issues without providing a clear-cut guilty/not guilty verdict in the issue.

### **Systems Theory and Program Evaluation:**

A system, according to Silvern (1972) is a structure of an orderly whole which clearly shows the interrelationships of the parts to each other and to the whole itself. The application of systems theory in education requires a total integration of program planning, curriculum development,



technical training (process) and final product. Therefore, two approaches within this theory should be considered when reviewing various techniques in program evaluation.

#### 1. DACUM: Development of a curriculum

Mager (1975), the modern day prophet of curriculum development, believes we often overlook the most important element in successful curriculum planning and development, namely, the establishment of an actual need for the course and of the real competencies required in the work force. Franklin and Mason (1977) would go further and argue that the main reason for lack of achievement in training programs has been the failure to identify accurately the real needs of the graduate and the employer.

Obviously, a more rational approach to curriculum identification and selection is required. Such an approach was developed in the late 1960's by the Experimental Projects Branch, Canada Development of Regional Economic Expansion and the General Learning Corporation of New York. DACUM (development of a curriculum) is a statement of an occupational profile which determines the skills required for a particular occupation. In responding to the question: "What



must be learned?", DACUM bases its answer on the actual work done within a given occupation. In its present form as designed by Robert Adams (1972), Nova Scotia Newstart Corporation, DACUM is a single-sheet skill profile and rating chart that serves as both a curriculum plan and an evaluation instrument for occupational training programs.

### DACUM Process

#### a) DACUM Committee

DACUM development utilizes the brainstorming technique within a carefully chosen group of 10-12 skilled practitioners and major specialists of a specific occupation over a period of three days. It is important to note that two groups are intentionally omitted from this committee: trained instructors in the occupation who tend to focus on the **HOW** of learning activities rather than the **WHAT** of skill behaviour required in the occupation and directors or executives who usually are unaware of the latest developments in the actual working areas. The structure of this committee is crucial and, as emphasized by the B.C. Brief on curriculum design (1975), must reflect a cross-section of industry with representation from large, medium and small institutions, from all geographic locations, from



all levels of experience and from all subtrades or disciplines within the occupation.

The group leader, acting as a catalyst, will prove to be the most important member of this committee. He does not need to be knowledgeable about or have extensive experience within the particular occupation. In fact, these characteristics may prevent him from remaining objective. However, he does need a broad background in curriculum development and task analysis and fluency in group dynamics in order to conduct the procedures effectively. He will examine the quality and accuracy of definitions presented, confirm the accuracy and validity of Committee evaluations and suggest re-evaluation where needed.

**b) DACUM Procedure**

The Coordinator leads the Committee through a series of steps:

**(i) Pre-DACUM Session**

An orientation session for all committee members should be held prior to the actual beginning of the DACUM session. At the preliminary committee meeting, the





Coordinator would explain the DACUM process and review the purpose, procedure and end product desired during the three day session. Mason (1984) would encourage that time be spent at this session or during the first morning to deal with the expectations and concerns of the group. This would establish a climate of trust, build group feeling and eliminate negative reaction to the actual DACUM process.

(ii) **General Areas of Competence:**

Through group discussion and brainstorming, the Coordinator assists in identifying the General Areas of Competence, based on actual conditions of employment, in which the individual must be proficient in order to obtain and maintain employment. Such division of skills may be related to specific divisions in the work assignments or areas into which the occupation naturally divides, or they may be merely a convenient method of grouping the skills. These General Areas of Competence, usually eight to twelve in any occupation, are then printed on 3 x 5 cards that can be



easily stuck on the wall for all to see and review.

**(iii) Individual Skills:**

Individual skills for each General Area of Competence that the individual must learn to become competent in the field are arranged in a horizontal band or row adjacent to the appropriate General Area of Competence. These skills are also printed on 3 x 5 cards that are stuck on the wall as in the previous step. No stress is placed on sequence of events and each row must be completed before another is begun. Since these skill definitions are destined to become learning units in the training program, they must reflect realistic future as well as current requirements and must be explicit enough to eliminate misinterpretation.

**(iv) Learning Sequence:**

Each row is carefully reviewed and a horizontal sequence is established according to the priority given to each skill by the occupation. Therefore, in structuring the skills into a learning



sequence, consideration must be given to skills needed early in the occupation, skills that are prerequisite to the learning of other skills that are most likely to be applied in many learning activities.

(v)      **Structure of Skills into Finished Profile:**

The entire structure is examined to identify similarities or duplications which may result in minor changes. Once again, Mason (1984) refines the original procedure by Adams by encouraging the members to review the chart individually before the group review. This allows the less vocal members of the group to participate and ensures a comprehensive and all-inclusive final profile.

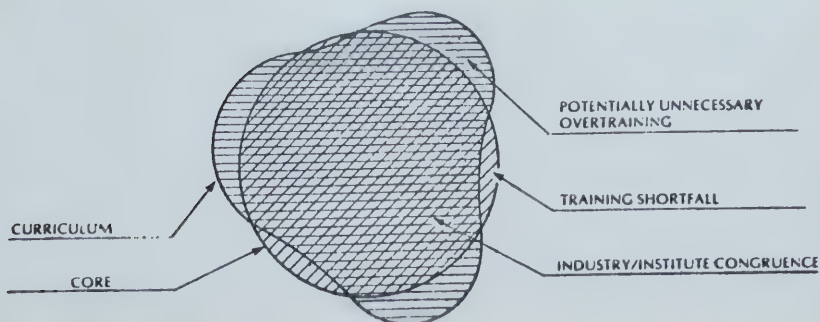
(vi)     **Final Inspection**

The DACUM chart is now complete. The skill definitions are now typed, numbered mounted and photoreduced for printing. Franklin and Mason (1977) insist that the skills shown in the DACUM chart be validated before the chart is published.



Worger and Morgan (1983) describe the validation process used at the Northern Alberta Institute of Technology. The list of skills under each general area of competence is sent out to a large sample of NAIT graduates and prospective employers. The graduates are asked to distinguish between "entry-level" skills while the prospective employers are asked to indicate the level of competence required for each skill at the end of one year of working experience. The analysis of this information, will indicate core content from "nice to know" or unnecessary curriculum and will identify training shortfalls or overtraining as shown in Figure 2.

FIGURE 2  
ANALYSIS OF VALIDATION RESPONSES







### c) RATING SCALE

Adams recognizes the difficulties in the evaluation of occupational training programs by applying precise measurement to a complex occupation and artificial performance standards (e.g. time restraints) that have very little bearing on performance in a real world situation. Therefore, DACUM focuses on observable behaviour and on realistic work situations in the same way that the employer in industry would view them. Each skill on the DACUM chart is defined in terms of the observable behaviour and it is on this behaviour only that an individual is rated by himself or another. This also assumes that there are several defined categories in the scale so that distinction of measurements and change could take place.

## 2. CAP System (Competency Analysis Profile System)

In the early 1970's, two professors from the Faculty of Education, University of Alberta, developed a systems theory, the CAP System, as a viable approach for the development of training programs. Based on competencies and on the development of performance levels within a given occupation, it was designed to



be used in the development of curriculum. As outlined by its authors, Manuel and Deane (1976) and Deane and Manuel (1977), there are five distinct phases in this CAP System:

#### **Phase I: Development of the Profile**

The profile referred to throughout the text is a comprehensive document of specific competence categories and complimentary competency statements required within a given occupation. Competent practitioners, selected on the basis of experience, specialization and work environment, develop this profile during an intensive brainstorming session. It is assumed that individuals working in the field have the most relevant information about the competencies required to function satisfactorily in the field.

The actual procedure is quite similar to the DACUM theory approach. A leader, skilled in group dynamics, leads the group to the development of a series of broad competency categories with complimentary competency statements describing the specific skills within each category.



Once the profile has been established, the team concentrates on rewording in precise behavioural terms. The resultant profile is now ready for validation by a much larger group of practitioners.

### **Phase II: Validation of the Profile**

The resultant CAP profile is now submitted to a larger segment of the occupation for scrutiny. This group will validate each competency category and statement, will add or delete competencies and statements as deemed appropriate to ensure that the final profile truly represents the entire occupation and will rank each skill or competency according to its relative importance.

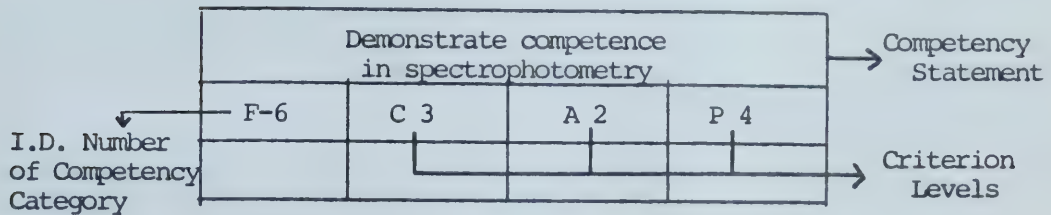
### **Phase III: Specification of Competencies**

The validated profile is now used by a new team of experts (including educators with proven experience in writing educational objectives) in the development of performance objectives and learning activities for each competency statement. Proficiency levels related to the three learning domains (Cognitive, Affective and Psychomotor)



are also prescribed and evaluation criteria are established. Each domain has four levels and the group must determine the minimum level for each domain of a competency block (see Figure 3).

FIGURE 3  
COMPETENCY STATEMENT  
WITH CRITERION LEVELS



The final product will be a booklet containing competency categories and each competency statement with the criterion levels for each of the domains of learning.

#### Phase IV: Preparation of Learning Resources

The CAP profile will now be used to develop self-contained learning modules for each competency statement. The learner will have complete access to these modules as well as alternate learning resources. These resources may include existing learning materials from other programs or commercial





companies. The essential components of a module would include a cover page, introduction, performance objectives, pre-assessment procedure, learning experiences and post-assessment measurement.

e) **Phase V: Establishment and Management of Delivery Systems**

This final phase attempts to interface the learner and the learning resources best suited for the attainment of his/her desired competencies. Records on individual learning progress are maintained and continuously updated.

The CAP system is a very practical response to the need for modularized learning activities in flexible occupational training programs.

## **EVALUATION INSTRUMENTS**

The actual choice of an evaluation instrument for the collection of data is based on the probable response rate, the expense, the complexity of information required and the speed with which answers must be obtained. The author will limit this literature review to a discussion on the use of the questionnaire and interview. Reference will also be



made to pre-testing of the evaluation instrument as a means of ensuring the reliability and validity of responses.

### Questionnaire:

The basic questionnaire is a useful instrument for gathering pertinent information at low cost from a large number of people living at a distance from the investigator. As pointed out by Bennett and Ritchie (1975) and the handbook on questionnaire design from Statistics Canada (1979), the visual appearance of the questionnaire may either arouse the respondent's interest or discourage him from cooperating.

Berdie and Anderson (1979) and Warwick and Leninger (1975) provide a series of suggestions to help stimulate a high percentage rate of response:

- (i) highly personalized relationship with respondents.
- (ii) professional looking correspondence and photo off-set questionnaire design. Printing allows the use of different sizes and styles of type to distinguish questions from instructions.
- (iii) strong appeal to altruism and the importance of the study



- (iv) use of sponsoring organization letterhead,  
if applicable
- (v) stamped, addressed return envelopes
- (vi) follow-up by mail or telephone

McCallon and McCray (1975) also stress anonymity as a means to obtain more accurate information. In this way, a person can express whatever he wishes without the fear of reprisal.

### **Introductory Letter:**

The front page or introductory letter should include an outline of the purpose of the study, the identification of the sponsoring organization, if applicable, the general instructions for completion and return of the questionnaire and the required date for completion. The handbook by Statistics Canada (1979) also stresses the necessity of providing assurances of the confidentiality to be given to the data provided.

### **Construction of the Questionnaire:**

The preliminary identifying information includes questions on respondent characteristics - age, sex, marital status, education, occupation - that will be used for classification purposes in the tabulations and analysis. The wording used should be familiar to and appropriate for the survey population. Precise instructions should be included on how to move ahead, how and when to skip certain



questions and so on.

It is advantageous to begin the questionnaire with a few interesting and "non-threatening" questions, including open-ended questions, that are sufficiently easy to give the respondent confidence to proceed further.

Two main question types may be defined, the open-ended and the closed question. An open-ended question does not suggest any specific response while the closed question requires the respondent to choose his answer from a given, limited selection. Due to the difficulty in statistically analyzing open-ended responses, this type of question is seldom used effectively. Closed questions may vary considerably in form and the questionnaire may contain check lists, ranking, two choice and multiple choice questions. In phrasing questionnaire items, the investigator should aim at communicating with the lowest rather than the average educational level of the potential population.

After designing the questionnaire, it is important to evaluate its validity and reliability or its potential usefulness as an instrument of measurement. Validity refers to the extent to which the questionnaire adequately probes the various areas it is supposed to measure (content validity), whether the questionnaire results agree with present theories on the relevant areas of the research





(construct validity) and the practical usefulness of the questionnaire as an instrument of identification (concurrent validity). We must also consider how reliable are the measurements by looking at internal consistency (consistency of answers to items).

Frequency counts are the principle index of data analysis for two choice or multiple choice questions. The chi-square can also be used to determine any significance of frequency differences. Responses to questions involving a rating scale and calling for a numerical value can be considered as direct input to a statistical analysis such as analysis of variance.

As stated previously, open-ended questions are difficult to analyze statistically. In order to compare responses, some form of "content analysis" is usually performed and responses are arbitrarily coded to a standard set of response categories designed by the investigator. Bennett and Ritchie (1975) maintain that this interpretative and judgmental procedure may be subject to considerable error and may destroy the main characteristic of open-ended questions by changing them into closed questions in order to apply standardized statistical analysis.

Before the questionnaire is finalized, the investigator



should set up a series of "dummy" tables with detailed column headings and line captions to indicate how the data will be summarized.

Warwick and Lininger (1975), Richardson, Dobrenwend and Klein (1960) and Bennett and Ritchie (1975) present a detailed outline of the advantages and disadvantages of the questionnaire. An investigator needs to weigh these benefits and limitations before choosing the evaluation instrument for the specific study. The advantages of a questionnaire include the ease of establishing contact, the ability to traverse geographical distances, the minimal cost, the possible sample size, the uniform question presentation, the ability to proceed at your own speed, and the ease of completion. On the negative side, the potential low response rate which could jeopardize validity, impersonalization and misinterpretation of questions may cause serious problems with any study.

### Pretesting

Even if all prescriptions are followed completely, there is no guarantee that the proposed questionnaire will fully satisfy the objectives of the study. Therefore, it is essential that a rigorous pretesting of the questionnaire be implemented to determine whether the research objectives are likely to be met by the proposed questionnaire.



This pretesting or pilot study should be performed with a sample of individuals who are similar to the individuals who will ultimately receive the actual final questionnaire. It is further recommended that the questionnaire might also be sent to "experts" in the field who can critique the investigator's efforts constructively.

Sletto (1940) enumerates the many benefits and rewards of such pretesting. It will increase the proportion of returns as well as the reliability and validity of responses, detect procedural mistakes before they exact heavy penalties, and formulate general acceptance of test wording, sequence, layout, choice of types of questions and use of questioning techniques. This should appease the critics who frequently and justly condemn the use of questionnaires in research endeavours.

#### INTERVIEW:

A survey is conducted to collect information in order to reduce one's uncertainty about existing affairs and/or to assist in future decisions in this regard. One of the most successful and widely used survey instruments in the interview.

To improve and ensure the success of any interview,



Adams (1958) recommends adherence to the following procedure:

- (i) **Establish rapport:** The success of any interview depends on the investigator's ability to create an atmosphere of confidence and trust with the prospective respondent. The first impression made on any respondent is very important and sets the stage for any further communication.
- (ii) **Setting:** The interview should be conducted in a quiet, comfortable area. Since the presence of other individuals may influence or bias the respondent's answers, the interview should usually be done in private.
- (iii) **Use of a questionnaire format:** The validity and reliability of the interview will be enhanced by the use of a questionnaire format. However, even with a set of questions, the investigator must be careful to follow the set procedure exactly: ask every question on the questionnaire, ask the questions in the order as presented and precisely as specified in the instructions. Any deviation in the format or presentation may jeopardize the





potential value of the data and its analysis.

(iv) **Closing of the interview:** At the end of the interview, another attempt should be made to return to any questions deliberately skipped because of threatened rapport and fear of honest response. In addition, the respondent should be assured at all times of the confidentiality of any information obtained during the interview. Finally, the respondent should be thanked for his/her participation.

(v) **Recording responses:** Responses should be recorded at the time they are made. The investigator should not rely on personal recall at a later date. When responses do not adhere to the established categories or procedures, the interviewer should be diligent in recording the exact words and phrases used by the respondent. This information may then be useful in the data analysis.

Richardson, Dobrenwend and Klein (1965) state that the use of the interview must be based on an objective assessment of its advantages and limitations in terms of the information to be gathered, the available sources of information and the personal characteristics and skills of



the investigator. Warwick and Lininger (1975) list the advantages of the interview as improved motivation of the respondent, greater flexibility in asking questions and in clarifying ambiguous questions and answers, independence from educational background and visual acuity and control over administration and sequence of questions. The disadvantages would include the expense, inappropriate sampling and failure to follow instructions in questioning.



# CHAPTER THREE

## METHODOLOGY AND INSTRUMENTATION

### Design of the Model

Having reviewed the various models and strategies in program evaluation, the author designed a comprehensive evaluation model applicable to any professional/technical program and used in this study to evaluate the national certification program in medical laboratory technology. This model is graphically presented in Figure 4.

FIGURE 4  
EVALUATION MODEL FOR NATIONAL  
PROGRAM IN MEDICAL LABORATORY TECHNOLOGY

| ANTECEDENTS (Inputs)                                                                                                                                                                       | PROCESS (Thruputs)                                                                                                                        | PRODUCT (Outputs)                                                                                                                                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Needs Assessment<br>- student needs<br>- program needs<br><br>2. DACUM Charts<br>- needs of prospective employer<br><br>3. Professional Organization (C.S.L.T.)<br>- professional needs | 1. Accreditation Process<br>- organization<br>- objectives<br>- learning resources<br>- facilities<br>- personnel<br>- evaluation process | 1. Certification Process<br>- examination results<br><br>2. Follow-up Survey<br>- new graduates<br><br>3. Employer Survey<br>- prospective employer |

#### A. Antecedents (Inputs):

An extensive needs assessment (student needs, employment needs, and professional needs) was developed to



provide necessary information for the establishment of overall goals and objectives for a national program for medical laboratory technology.

## 1. Needs Assessment Survey

A questionnaire was designed and administered to the program heads of all approved training programs in Canada (as listed in Appendix A) regarding admission requirements and program structure. This questionnaire provided specific information in the following areas:

### a) Admission Requirements:

- (i) A list of matriculation subjects required for admission
- (ii) The minimum G.P.A. required for admission
- (iii) The use of interviews/references in selection process
- (iv) Any additional requirements for admission
- (v) Admission regulations following junior or senior matriculation

### b) Program Structure:

- (i) Length of didactic phase in institute.





- (ii) The time required to teach/learn the theoretical knowledge and practical competencies required by the new graduate.
- (iii) The skills best learned in the clinical laboratory environment.
- (iv) The content of the Syllabus of Studies in relationship to:
  - a) essential theory, competencies and/or skills
  - b) non-essential theory, competencies and/or skills
  - c) advanced level theory, competencies and/or skills
- (v) The relationship between the C.S.L.T. Syllabus of Studies and examinations and the actual needs of the new graduate in the work place.

## 2. DACUM Charts in Medical Laboratory Technology

The assessment of the needs of the employer was seen as an essential component in the establishment of a realistic and comprehensive national program of study in medical laboratory technology. This would ensure that the program would reflect the theory, compe-



tencies and skills required by the new graduate in the actual work place.

Since the author did not believe in "inventing the wheel" to obtain this information, the two existing DACUM charts - as shown in Appendices B and C - representative of two major geographical regions in Canada (Alberta and Ontario) were used in this study. It was assumed that these DACUM charts, validated by a follow-up survey of graduates and/or an employment survey of prospective employers, would adequately represent the actual needs of the new graduate in the work place across Canada. This information was reviewed and critiqued and subsequently used in the development of the proposed follow-up survey and employer survey.

### 3. Professional Certifying Organization

In establishing the antecedents, some consideration must be given to the administrative policies and guidelines established by the national certifying body, the Canadian Society of Laboratory Technologists. It must be recognized that although a great deal of flexibility is



allowed within each educational institution and clinical facility, the approved Syllabus of Studies must be adopted as the basis for program development and approval and therefore, prospective students must be academically prepared for these requirements. The author will study the needs of the profession by a brief review of the history of admission requirements and length of training programs.

#### B. Process (Thruputs)

Each approved training program in medical laboratory technology in Canada is subject to an accreditation by an external evaluation team every five years. This accreditation, under the auspices of the Conjoint Committees on Accreditation of Educational Programs for Allied Medical Disciplines of the Canadian Medical Association, judges whether the program fulfills the required objectives and is being implemented as planned. Following the "Basis for Accreditation" guidelines, this team will review program components: organization, objectives, instructional activities, evaluative procedures, personnel, didactic and clinical facilities, libraries and study areas, and resources.

The author will review the present accreditation



process, its strengths and weaknesses, and will pose suggestions for possible greater effectiveness through more institutional and "external" participation in the actual accreditation process.

### C. Product (Outputs)

In order to obtain an accurate and realistic measurement of the product (the graduate) and the overall effectiveness of the national program, the following instruments for data collection were designed:

#### 1. Certification Examination Results:

The results of the initial certification examinations held every June and October were examined for a five-year period (1980-84). It is believed that the success rates will provide some factual indication of the relative effectiveness of the national certification program.

#### 2. Follow-up Survey:

A student follow-up survey (1982-84) was designed to provide necessary information regarding the strengths and weaknesses of the training program as well as its ability to prepare graduates for the work place.





### 3. Employer Survey:

A mail questionnaire/rating form was designed to survey prospective employers regarding the new graduate's performance on the job. This will help to assess program objectives in relation to desired competencies in the field.

The DACUM charts previously reviewed and the present Syllabus of Studies were useful in the design of the follow-up and employer surveys.

The author recognized the possible weaknesses and disadvantages of questionnaires but felt that they were the instrument of choice for this study since the individuals to be surveyed were located throughout Canada. In addition, the time and cost involved in using a more acceptable technique, such as the interview, made it prohibitive.

To improve the validity of all survey questionnaires, they were field tested and revised where necessary before being included in the model. The needs assessment survey was reviewed, amended and approved by the members of the Certification Board; the follow-up survey was reviewed by the members of the Certification Board, piloted by a random sampling of graduates living in Alberta and revised ac-



cordingly; the employer survey was reviewed by the members of the Certification Board, piloted by a random sampling of prospective employers in Alberta and revised accordingly.

To ensure a good return to the surveys, a letter of support from the professional organization (C.S.L.T.) was drafted to be included with the questionnaires and the stamped addressed return envelope. The author is confident that the survey response will be high (over 80%) since the individuals to be surveyed (graduates and employers) are intimately involved in and concerned with the thrust and focus of the study.

## Design of the Instrument

### 1. Needs Assessment Survey

The needs assessment survey package is included as Appendix D. The training program questionnaire was developed as outlined in the initial design of the model. A letter of support from the professional organization, a note ensuring confidentiality of information and a stamped return envelope addressed to the author and stamped "PERSONAL AND CONFIDENTIAL" were also included with each questionnaire.

Since the C.S.L.T. is a recognized bilingual



professional organization, all information outlined above was translated into French to facilitate responses from the C.E.G.E.P. training programs in the Province of Quebec.

This package was reviewed and amended by the Certification Board of the C.S.L.T. and was revised accordingly by the author prior to distribution. The author's initial intention was to design this needs assessment survey only. However, as the development of the instruments progressed, it was recognized that data from this survey could prove invaluable in the design of the follow-up and employer surveys. Therefore, the needs assessment package was designed and distributed to all training programs in Canada in late November, 1984.

In January, 1985, with only 50% of the questionnaires returned, the author sent a follow-up letter to encourage greater participation in the survey. The inappropriate timing of the initial questionnaire (Christmas mailing) was the cause of this poor response and the letter of reminder resulted in a final response of over 85%.



## 2. Follow-up Survey

Initially, a follow-up survey was proposed to poll a test sample of 1,500 randomly selected graduates (1980-84) from training programs across Canada. The total population to choose from would be 5,402 graduates. The author further proposed a stratified random sampling to ensure an appropriate representation of graduates by sex, location, programs, etc.

However, further investigation favoured the reduction of the number of years to be investigated from five years (1980-84) to three years (1982-84). It was felt that it would be difficult to recall actual training practices and procedures beyond a three-year period. In addition, the C.S.L.T. agreed to finance a follow-up survey of all graduates between 1982 and 1984, namely 2,411 individuals. Since registration with the C.S.L.T. is not compulsory for employment, some bias may still be present even if the entire population is surveyed since some graduates are no longer registered members in good standing. However the author believes that this is the best sampling possible in the given situation.

The follow-up survey package, incorporated as





Appendix E, includes the following information:

- a) a letter of support from the professional organization
- b) an instruction page of detailed guidelines for the completion of the questionnaire
- c) each section of the questionnaire will be color-coded for ease of response and data analysis. This is important because each graduate answers only certain sections of the questionnaire
- d) the entire package will be typeset to improve its professional quality and visual appeal
- e) five prizes for free 1986 C.S.L.T. membership will be offered as an incentive for the prompt completion of the questionnaire
- f) a stamped return envelope addressed to the author and marked PERSONAL AND CONFIDENTIAL
- g) all information will be translated into French to facilitate responses from the Francophone graduates

Since the actual survey will not be carried out as part of this study, the author was careful to include three methods of pretesting the survey



package: the entire package was designed with the assistance of the instructional staff of the Medical Laboratory Science program at the University of Alberta. Each instructor received the general information and her specific discipline section to critique for wording of questions, format, and accuracy of content. The package was then reviewed and revised further by the C.S.L.T. Executive staff and the Certification Board. As a final check, the questionnaire was piloted by the fourth year students of the Medical Laboratory Science program who represent a sampling of the graduates who would ultimately receive the final package. The author feels that this pretesting has been quite rigorous and that the final product will produce the desired results.

### 3. Employer Survey

The design of the employer survey package was the easiest section of the entire study because the covering letter, instruction page, and questionnaire followed the same format and content as the final follow-up survey.

However, the establishment of an appropriate



sampling of the prospective employer population caused some concern to the author. When the diversity of prospective employers was considered - hospitals, clinics, private laboratories, government laboratories, research laboratories, educational institutions as well as industrial and commercial organizations - it was recognized that an accurate sampling would be impossible since a composite listing of all employers was not readily available. Therefore, recognizing this as a further delimitation of the study, the author decided to survey a sampling of hospitals, clinics, and private laboratories in Canada since these employers account for 80%-90% of all medical laboratory technologists. A listing of all Canadian hospitals was available from the Canadian Hospital Directory and a similar listing for clinics and private laboratories in the major provinces of Ontario, Alberta, and British Columbia was available from the respective provincial organizations. Since a 500 bed general hospital is considered the "standard" size for the purpose of comparative studies, a stratified random sampling of 500 hospitals (400-600 beds) was recommended. All major clinics and private laboratories in the three provinces were included in the sample.



The employer survey package, submitted as Appendix F, included the following information:

- a) a letter of support from the professional organization
- b) an instruction page of detailed guidelines for the completion of the questionnaire
- c) each section of the questionnaire will be color-coded for ease of response and data analysis. This is important because each employer answers only certain sections of the questionnaire
- d) the entire package will be typeset to improve its professional quality and visual appeal
- e) a stamped return envelope addressed to the author and marked PERSONAL AND CONFIDENTIAL
- f) all information will be translated into French to facilitate responses from Francophone employers

Since the actual survey will not be carried out as part of this study, pretesting of the survey package by two groups was included: the entire package was reviewed by the C.S.L.T. Executive office staff and the Certification Board for format, wording, and accuracy of content.





After revision, the questionnaire was piloted by a sampling of prospective employers within the Edmonton area, including hospitals and private laboratories. The author feels that the final version of this employer survey package will produce a valid and reliable response from participants which can be used in program evaluation by the C.S.L.T.

It goes without saying that the potential number of responses that could be generated by the graduate and employers surveys necessitates the use of computer data software in the analysis and interpretation of data.

Therefore, the C.S.L.T. should consider the use of either optical scorer sheets or the development of a proper coding system for all variables in each survey. Obviously, the author would recommend the use of optical scorer sheets in the printing of each questionnaire as this would eliminate the time consuming key punching procedure and reduce the possibility of errors in transcribing the data onto the computer cards.



# CHAPTER FOUR

## PRESENTATION AND INTERPRETATION

### OF FINDINGS

#### A. ANTECEDENTS (INPUTS)

##### 1. Needs Assessment Survey:

Twenty-seven (87.1%) of the training program questionnaires were completed, returned and tabulated. Through the calculation of frequency distributions, the following data was recorded:

Table 1: Distribution of Responses

|                    |   |    |         |
|--------------------|---|----|---------|
| British Columbia   | : | 2  | (100%)  |
| Prairie Provinces  | : | 6  | (100%)  |
| Ontario            | : | 10 | (90.1%) |
| Quebec             | : | 6  | (66.7%) |
| Maritime Provinces | : | 3  | (100%)  |

Table 2: Admission Requirements

|                                                 |                    |    |         |         |
|-------------------------------------------------|--------------------|----|---------|---------|
| 1. Admission to program from:                   | a) grade 11        | :  | 2       | (7.4%)  |
|                                                 | b) grade 12        | :  | 19      | (70.4%) |
|                                                 | c) grade 13        | :  | 3       | (11.1%) |
|                                                 | d) grade 12 or 13: |    | 3       | (11.1%) |
| 2. Required subjects at above level:            |                    |    |         |         |
| a) Chemistry                                    | :                  | 27 | (100%)  |         |
| b) Mathematics                                  | :                  | 26 | (96.3%) |         |
| c) English                                      | :                  | 16 | (59.3%) |         |
| d) Combination (physics or biology)             | :                  | 10 | (37.0%) |         |
| e) Physics                                      | :                  | 10 | (37.0%) |         |
| f) Biology                                      | :                  | 5  | (18.5%) |         |
| g) Combination (2 of physics, math and biology) | :                  | 2  | (7.4%)  |         |



Table 3: Minimum/Mean Average Required

|                                      |                  |
|--------------------------------------|------------------|
| a) per subject                       | range: 50% - 65% |
| b) overall                           | 60% - 70%        |
| c) mean average/successful candidate |                  |
| (i) 1984-85:                         | range: 68% - 80% |
| (ii) 1983-84:                        | 65% - 80%        |
| (iii) 1982-83:                       | 63% - 77%        |

Table 4: Additional Admission Requirements

|                                               |   |            |
|-----------------------------------------------|---|------------|
| a) medical examination                        | : | 13 (48.2%) |
| b) personal interview                         | : | 12 (44.4%) |
| c) letter of interest/<br>personal objectives | : | 11 (40.7%) |
| d) tour of laboratory/<br>hospital interview  | : | 8 (29.6%)  |
| e) references                                 | : | 5 (18.5%)  |
| f) pre-entrance testing                       | : | 5 (18.5%)  |
| g) none                                       | : | 2 (7.4%)   |

### Interpretation:

The above information provided a general summary of entry antecedents and academic requirements for a medical laboratory program in Canada.

These findings indicated the recognized need of a strong foundation in the sciences, especially Chemistry and Mathematics, for entrance into and successful completion of the program. At the same time, it indicated one possible weakness in the admission requirements, namely, the omission of English as a compulsory course in 6 out of the 22



(27.3%) English programs. Since good communication skills are an essential element in the profession, this omission was found to be inappropriate and professionally weak.

It was noted that the mean high school average of successful candidates was much higher than the required overall averages cited by most institutional programs. This was not surprising or unusual in a specific professional program with limited or quota enrolment. The additional admission requirements seemed appropriate and demonstrated the renewed emphasis on comprehensive knowledge of the profession, on personal objectives, and motivational factors.

Table 5: Program Structure (Didactic Segment)

|                                                                                                          |                 |   |            |
|----------------------------------------------------------------------------------------------------------|-----------------|---|------------|
| 1. Length of program:                                                                                    | 2 years         | : | 7 (25.9%)  |
|                                                                                                          | 3 years         | : | 17 (63.0%) |
|                                                                                                          | 2 or 3 years    | : | 3 (11.1%)  |
| 2. Length of didactic training:                                                                          | 16 - 22 months: |   | 18 (66.7%) |
|                                                                                                          | 9 - 10 months:  |   | 9 (33.3%)  |
| 3. % of first year (in two-year didactic programs)<br>DIRECTLY related to medical laboratory technology: |                 |   |            |
| a)                                                                                                       | less than 25%   | : | 9 (50.0%)  |
| b)                                                                                                       | 25% - 50%       | : | 7 (38.9%)  |
| c)                                                                                                       | 50% - 75%       | : | - (0%)     |
| d)                                                                                                       | over 75%        | : | 1 (5.6%)   |
| e)                                                                                                       | no response     | : | 1 (5.6%)   |
| 4. Sufficient time to TEACH core content?                                                                |                 |   |            |
| a) two-year program:                                                                                     | Yes:            |   | 13 (72.2%) |
|                                                                                                          | No :            |   | 5 (27.8%)  |
| b) one-year program:                                                                                     | Yes:            |   | 6 (66.7%)  |
|                                                                                                          | No :            |   | 3 (33.3%)  |





### Interpretation:

The general consensus favoured a two-year didactic segment for the program. Four of the "YES" responses from the one-year program, indicated some reservation in the continuance of a one-year program citing student stress and frustration, inability to teach necessary communication skills and limited concentration on core subjects as reasons for dissatisfaction. One program head summed it up nicely by stating that "if the trend (towards unlimited information) continues, either the required information will have to be restricted or the time (of program) will need to be lengthened".

Table 6: Program Structure (Clinical Segment)

|                                                     |     |         |  |
|-----------------------------------------------------|-----|---------|--|
| 1. Length of clinical training:                     |     |         |  |
| 11 - 12 months:                                     | 19  | (70.3%) |  |
| 8 - 10 months:                                      | 7   | (26.0%) |  |
| no response                                         | : 1 | (3.7%)  |  |
| 2. Structure:                                       |     |         |  |
| a) "hands-on" system:                               | 20  | (74.1%) |  |
| b) simulated system :                               | 3   | (11.1%) |  |
| c) both a) and b) :                                 | 3   | (11.1%) |  |
| d) no response                                      | : 1 | (3.7%)  |  |
| 3. Sufficient time to TEACH practical competencies? |     |         |  |
| Yes:                                                | 21  | (77.8%) |  |
| No :                                                | 4   | (14.8%) |  |
| No Response:                                        | 2   | (7.4%)  |  |



Table 7: Skills Best Learned in the Clinical Laboratory Environment

|                                               |      |         |
|-----------------------------------------------|------|---------|
| a) communication/interpersonal relationships: | 13   | (48.1%) |
| b) organizational/prioritizing skills         | : 12 | (44.4%) |
| c) instrumentation/automation                 | : 12 | (44.4%) |
| d) phlebotomy/specimen procurement            | : 6  | (22.2%) |
| e) application: theory to practice            | : 6  | (22.2%) |
| f) proficiency in practical skills            | : 6  | (22.2%) |
| g) handling stressful/stat situations         | : 4  | (14.8%) |
| h) record keeping                             | : 4  | (14.8%) |
| i) interpretive skills                        | : 4  | (14.8%) |
| j) professional responsibilities              | : 3  | (11.1%) |
| k) trouble shooting                           | : 3  | (11.1%) |

#### Interpretation:

The program heads felt more satisfied with the clinical segment than with the didactic segment. However, there was still some concern regarding student pressure "to perform", outdated/unnecessary material in the Syllabus, certain disciplines included in the general certification program and insufficient time for practical competencies in some disciplines and in simulated programs.

The list of skills best learned in the clinical laboratory environment was very enlightening to the author. The majority of these skills, practical in nature in a "hands-on" situation, cannot be tested in a written multiple-choice examination. In addition, there is some question



whether such skills can be taught or learned (e.g. handling stressful situations) in a professional program. Therefore, it will be quite difficult to evaluate the success of the program in this regard.

**Table 8: Summary (program Structure)**

|                                                           |                 |                |  |
|-----------------------------------------------------------|-----------------|----------------|--|
| 1. Sufficient time to teach/learn core content:           |                 |                |  |
| a) Didactic segment:                                      | Yes: 18 (72.0%) | No: 7 (28.0%)  |  |
| b) Clinical segment:                                      | Yes: 22 (88.0%) | No: 3 (12.0%)  |  |
| c) Total Program :                                        | Yes: 23 (92.0%) | No: 2 (8.0%)   |  |
| d) No Response :                                          | 2               |                |  |
| 2. Sufficient time to teach/learn practical competencies: |                 |                |  |
| a) Didactic segment:                                      | Yes: 15 (60.0%) | No: 10 (40.0%) |  |
| b) Clinical segment:                                      | Yes: 19 (76.0%) | No: 6 (24.0%)  |  |
| c) Total program :                                        | Yes: 19 (76.0%) | No: 6 (24.0%)  |  |
| d) No response :                                          | 2               |                |  |

### Interpretation:

In co-relating the above summary to the previous section, the author noted one very significant point. Although 76% of the program heads felt that there was sufficient time within the TOTAL PROGRAM to teach/learn the required practical competencies, only 60% felt that there was sufficient time for such competencies in the didactic portion of the program. In addition, only 72% felt that there was sufficient time to teach/learn core content in the didactic segment



where the bulk of theoretical teaching/learning is carried out. The author found these figures to be very significant and worthy of further study. These figures seem to confirm the need for a three-year program with two years in the didactic segment.

Table 9: Validation of Syllabus

|                                                                                                                                  |                        |
|----------------------------------------------------------------------------------------------------------------------------------|------------------------|
| 1. Does the Syllabus of Studies contain theory, competencies, and/or essential skills required by the new graduate?              |                        |
| Yes:                                                                                                                             | 12 (44.4)              |
| No :                                                                                                                             | 13 (48.2%)             |
| No Response:                                                                                                                     | 2 (7.4%)               |
| 2. Does the Syllabus of Studies contain theory, competencies, and/or skills that are not essential/required by the new graduate? |                        |
| Yes:                                                                                                                             | 13 (48.2%)             |
| No :                                                                                                                             | 10 (37.0%)             |
| No Response:                                                                                                                     | 4 (14.8%)              |
| 3. Does the Syllabus of Studies contain theory, competencies, and/or skills that should be reserved to an advanced level?        |                        |
| Yes:                                                                                                                             | 3 (11.1%)              |
| No :                                                                                                                             | 22 (81.5%)             |
| No Response:                                                                                                                     | 2 (7.4%)               |
| 4. Do the C.S.L.T. examinations adequately reflect:                                                                              |                        |
| a) the Syllabus of Studies?                                                                                                      | Yes: 20 (74.1%)        |
|                                                                                                                                  | No : 5 (18.5%)         |
|                                                                                                                                  | No Response: 2 (7.4%)  |
| b) the needs of the graduate?                                                                                                    | Yes: 11 (40.7%)        |
|                                                                                                                                  | No : 9 (33.3%)         |
|                                                                                                                                  | Unknown: 2 (7.4%)      |
|                                                                                                                                  | No Response: 5 (18.6%) |





### Interpretation:

It was significant that almost half of the program heads felt that the Syllabus of Studies did not contain essential theory, competencies and skills needed by the new graduate. We may have to "live with" this situation to some degree since the process of Syllabus revision is time consuming and makes an up-to-the-minute Syllabus an impossible task. However, one must remember that the Syllabus is only a GUIDE and should not be regarded as the final word on medical laboratory technology. At the same time, the author recognized that there are some areas that need attention such as parasitology, serology, and certain sections in microbiology.

Almost half of the program heads felt that they are teaching and examining in non-essential areas. Without going into a long list of specific tests in each discipline, the responses questioned the emphasis on manual methods and obsolete testing procedures.

The purpose of any professional training program is to meet the needs of the graduate and of the work place. It is extremely significant that less than half (40.7%) of the program heads



felt that the C.S.L.T.'s product evaluation process (examinations) reflected this purpose. Many respondents felt that the examination questions were totally irrelevant to current practice.

Although not specifically requested, many respondents commented on the examinations themselves. There was a great deal of concern over inconsistency in weighting of questions, importance of topics and required depth of knowledge.

## 2.DACUM Charts in Medical Laboratory Technology

A quick review of the limited information available on the use of DACUM in the education of health care workers clearly reveals that the originator, Robert Adams, is probably the only individual using the DACUM process and resulting rating chart as they were initially designed! It would appear that most educators including medical laboratory technology instructors are indifferent to the original purpose of the DACUM system and agree with Sinnett (1974) that DACUM is only a tool, a means to an end, and as such should be flexible and capable of changing and evolving with use.



This evolution and change is quite evident in the formation and execution of the actual DACUM Committee. The two DACUM charts under consideration in Appendices B and C were developed by educators and clinical instructors with minimal input from working technologists. Therefore, they do not truly represent the "real job" type of curriculum which the original DACUM prescribed.

Another evident discrepancy was the establishment of the General Areas of Competence. Adams' procedure (1972) for the determination of specific skills required in a particular occupation failed to identify "the skills required BY WHOM in the particular occupation". Do we consider the skills needed by a new graduate or the complete gamut of the entire field of medical laboratory technology regardless of experience or level of classification? This became a crucial question when examining the existing DACUM charts since they contained numerous competencies required by a new graduate AND by a senior or supervisory technologist.

The DACUM chart was designed to be used as a student syllabus and as a cumulative record of student performance. Therefore, it should contain



ONLY those Areas of Competence required by a new graduate. Although the skill definitions were intended to reflect future as well as current requirements and the Committee was requested to predict what skills will be needed in the immediate future, a specific skill should not be included unless there was a clear indication that the graduate will be expected to apply the skill in his first job.

Adams (1972) also recognized two extreme tendencies of a Committee faced with the assignment of breaking down and sorting the individual skills of its occupation: breaking skills down too finely until they actually represented the tasks within the skill or making skill definitions too encompassing or writing them in terms of global definitions. It is a natural reaction either to overestimate the occupation in the number of skills it contains or to analyze the skills improperly due to a lack of actual working knowledge in the occupation. The author believes that Appendix C contains the tasks within each skill rather than the individual skills only.

Due to the above concerns and deviations, the author questioned the validity of either DACUM





chart and therefore, used them sparingly in the preparation of the follow-up and employer surveys.

### 3. Professional Certifying Organization

In its Charter of Incorporation (1937), the C.S.L.T. cited the improvement of qualifications and standards for medical laboratory technologists in Canada as its main objective. This mandate has continued for almost fifty years.

Initially, senior matriculation with chemistry, either physics or biology and mathematics was required for admission into an approved training program. The Report from the Long Range Planning Committee (1979), approved by the C.S.L.T. Board of Directors, phased out the professional organization's participation in the assessment of educational qualifications. The responsibility for assessment of entry level requirements is now the responsibility of the respective Community College or Institute of Technology which offers the program. However, as will be noted in the results from the needs assessment survey of the educational institutions, the requirements for admission have not changed appreciably over the years.



As outlined in the previous background information, on-the-job exposure to the major disciplines was the pattern of training in the early years of the C.S.L.T. In the 1960's, there was a definite trend towards a more formal structure with a two-phase approach to training:

- a) **DIDACTIC TRAINING:** given in an academic setting and consisting of lectures, assignments, and laboratory demonstrations
- b) **CLINICAL TRAINING:** one year in an approved training laboratory with emphasis on the practical application of the basic sciences and technical component taught in the didactic segment of the program.

These changes coincided with the establishment of the C.S.L.T. Certification Board and a newly defined certification program in recognition of the rapidly expanding field of medical laboratory technology. The Submission to the Royal Commission on Health Sciences (1969) stressed that the training for medical laboratory technologists in Canada should be for a period of 18 months with a minimum of 4-6 months in the didactic setting. Although the literature from the C.S.L.T. no



longer specifies the actual length of a training program (in months), the needs assessment survey showed that the minimum length of the training program is 18 months, 9 months of didactic training and 9 months of practical training.

#### B. PROCESS (THRUPUTS) EVALUATION BY ACCREDITATION

All allied medical educational programs are accredited by the Conjoint Committee of the Canadian Medical Association in conjunction with the respective associations and societies. It is the author's personal belief that this method is effective and appropriate as a process evaluation for occupational training programs such as medical laboratory technology. Therefore, the author's program evaluation model would continue the process as outlined below.

The purpose of the national conjoint accreditation, as stated in the Basis of Accreditation (1982), is as follows:

- (i) to provide an external audit for programs
- (ii) to bring to educational programs a national perspective
- (iii) to assist in maintaining national standards
- (iv) to promote national portability of qualifications
- (v) to monitor changing patterns of practice and



developments in health care and, where necessary, to see that such changes are incorporated into program design

- (vi) to offer advise and assistance to existing programs (page v)

The specific requirements for accreditation in medical laboratory technology include all aspects of training in both the didactic and clinical phase of each program to ensure that the quality and standards of training will qualify candidates to write the certification examinations set by the registering body, the Canadian Society of Laboratory Technologists.

#### 1. Program Objectives:

The accreditation team will examine the objectives of each program and the methods used to evaluate the students' success in meeting these objectives. To provide the maximum opportunity for success, each program must incorporate the following elements:

- (a) adequate performance of all clinical laboratory procedures outlined in the Syllabus of Studies for national certification.
- (b) proficiency in the safe and effective use of all laboratory equipment and





apparatus.

- (c) recognition of results falling outside the acceptable reference criteria and appropriate action in such cases.
- (d) collation and understanding of statistical information and quality assurance procedures.

## 2. Length of Program:

At present, a minimum of 20 months (preferably 24 months) following senior matriculation or equivalent is approved as the acceptable length of an educational program in medical laboratory technology to ensure that students can meet all the program objectives.

## 3. Components of the Program:

The essentials of the training program must include adequate didactic and practical instruction and clinical bench instruction to ensure that all aspects of the required disciplines are understood:

General Orientation

General Laboratory Knowledge

Clinical Biochemistry

Clinical Hematology



Clinical Microbiology

Immunohematology

Histotechnology

**(a) Didactic Phase:**

The academic or didactic phase should operate with the assistance of an Advisory Committee representing associated groups and participating clinical laboratories. This will ensure effective integration of and liaison between the didactic and clinical components of the program as well as the maintenance of national standards and relevant curriculum content.

Personnel offering didactic courses should possess appropriate qualifications and clinical experience in the area(s) they teach with additional evidence of current clinical exposure and continuing professional education. The period of instruction should be at least one academic year.

**(b) Clinical Phase:**

Clinical practical training of 10-12 months takes place in an accredited



clinical laboratory under adequate supervision. All instructors should have relevant qualifications and clinical experience to ensure a high level of training in all disciplines.

Instructor/student ratio should be conducive to the attainment of program goals and objectives and consistent with good teaching practice.

#### 4. Educational Facilities:

The accreditation team will assess the adequacy of the physical facilities as they tour them. This will include:

- (a) adequate classroom and laboratory facilities
- (b) suitable study areas in both didactic and clinical areas
- (c) library facilities
- (d) learning resource facilities
- (e) modern equipment

#### 5. Program Records:

The accreditation team will also review all student, instructional and administrative records during its on-site visit. This review will include:



(a) **Student records:**

- admission records with official transcripts
- evaluation records of student progress
- health records (immunization)
- rotation schedules in clinical portion of training

(b) **Instructional records:**

- procedural/instructional manuals
- log books
- tests, examinations

(c) **Administrative records:**

- minutes of committee meetings
- policies on selection and promotion procedures
- curriculum revision policies

**C. PRODUCT (OUTPUTS) EVALUATION**

**1. Certification examination results:**

As stated previously, the success rate on examinations will usually give some indication of the effectiveness of a national certification program. In fact, Tyler (1942) and many others would go so far as to insist that if an examination truly measures the goals and objectives of a pro-





gram, a high success rate means that the program is successful and a low success rate indicates that the program is inadequate.

Appendix G represents the R.T. initial certification examination results during the past five years (1980-1984). Based on the above premise, this success rate indicates that the overall national certification program for medical laboratory technologists in Canada is quite successful.

This is not surprising. The admission requirements are quite rigorous and guarantee that each program will lure the academic "cream of the crop" from the secondary school system. In addition, the extensive evaluation process in the didactic and clinical segments serves to eliminate the undesirable. Therefore, those who survive **SHOULD** pass! Thus goes the argument of the "defenders of the system" who insist that the examination results are an accurate reflection of the quality of the program and the dedication of the instructors.

Although the national certification program is a good program that turns out a good product,



the author feels that there are areas of concern that should be considered/analyzed in the product evaluation:

a) **INFLATED MARKS VS. ACTUAL MARKS**

Each training institution and clinical facility is provided with a copy of all previous examinations. The question banks for these multiple-choice examinations are extremely limited and, therefore, the examinations do not change appreciably from year to year. Many teaching technologists maintain that given the appropriate examinations over a five year period, they could "program" most individuals with average intelligence and no laboratory experience to pass the certification examinations.

If this is true - and the author believes it is - it could mean that many individuals have "beat the system" and that the published marks are not really a reflection of the quality of the program and the trainees but a record of the student's ability to memorize set questions and answers.



b) ALLEGED GOALS VS. REAL GOALS:

Examination results, the successful fulfilment of stated objectives, do not respond to the more basic question of Atkin (1973), namely, the merit and value of the objectives/program. Does the existing training reflect the actual needs and essential skills required by the new graduate and the prospective employee?

These questions will be dealt with in greater detail in the chapter on conclusion/recommendations.

## 2. Follow-up Survey/Employer Survey

Since this study does not include the actual collection and analysis of data from the above surveys, there will be no data analysis performed. However, the author will indicate how the generated data should be analyzed when the surveys are completed at a later date. Since the procedure for statistical analysis for both follow-up and employer surveys will be identical, they will be discussed as one unit at this time.

As stated previously, the final questionnaires



will be designed to accommodate the use of optical scorer sheets or key punching technique for data analysis. This will facilitate the use of SPSS (Statistical Package for the Social Sciences) for data analysis. Once the questionnaires have been returned, the following procedure will be followed:

- 1) a number of DATA FILES, a separate file for each major section, will be created using the scorer sheets or coded results from both surveys. Separate files are essential because of the number of variables, and the variation in number of responses per section.
- 2) once (1) has been completed, the distribution characteristics of each variable under investigation will be obtained and examined. This will include frequency distribution, variability, and central tendencies of each variable. The author will be most interested in the MEDIAN and MODE of each variable.
- 3) investigations will be carried out to establish the relationship between two or more of the variables. This will





include crosstabulation analysis and correlation analysis.

- 4) since similar information from different groups will be obtained, the difference of proportions of these groups will be compared to see if a significant difference is present (independent t-test and ANOVA).

### Proposed Statistical Applications

#### A. Frequency Distributions:

In order to properly determine the significance of the data, particularly median and mode for each variable, the C.S.L.T. decision-makers (Board of Directors, exam panels, and Certification Board) must determine WHAT should be considered SIGNIFICANT data. For example, if 40% of all responses feel that a particular item (variable) on the Syllabus should no longer be included, consideration should be given to removing it from the Syllabus during the next revision.

#### B. Crosstabulation Tables:

After the distribution of each variable has been examined and interpreted as



stated above, the relationship between two or more variables can be investigated by the use of crosstabulation tables. The author believes that this will provide significant information for the study. For example, we can examine the relationship between examination requirements and work place requirements or the relationship between the level of knowledge required at the work place and the depth required by the Syllabus of Studies as shown in Table 10 and Table 11, respectively.

TABLE 10: EXAM REQUIREMENTS VS. WORK PLACE REQUIREMENTS

|                               |     | Should be Required<br>for Examination |        |
|-------------------------------|-----|---------------------------------------|--------|
|                               |     | YES                                   | NO     |
| Required in<br>the work place | YES | AREA 1                                | AREA 2 |
|                               | NO  | AREA 3                                | AREA 4 |



TABLE 11: LEVEL REQUIREMENT IN THE WORK PLACE VS. DEPTH OF SYLLABUS OF STUDIES

| Depth of Syllabus of Studies                    |                 |      |                        |
|-------------------------------------------------|-----------------|------|------------------------|
|                                                 | TOO<br>DETAILED | OKAY | NOT DETAILED<br>ENOUGH |
| Level of<br>Requirement<br>in the Work<br>Place | NICE TO<br>KNOW |      |                        |
|                                                 | OFTEN<br>NEEDED |      |                        |
|                                                 | ESSENTIAL       |      |                        |

Once again, the C.S.L.T. decision-makers must determine WHAT is to be considered significant. For example, if the result in Area 1 in Table 10 was 70%, meaning that 70% feel that this particular item (variable) is required for both the examination and the work place, the Syllabus revision committee could confidently retain this item. Conversely, if the result in Area 4 in Table 10 was 70%, meaning that 70% feel that this particular item (variable) is not required for either the examination or work place, the Syllabus committee could confidently delete this item.









TABLE 13: GRADUATES VS. EMPLOYERS

|                                            |                    |      |                       |                   |                          |                 |                            |                       |                 |  |  |  |
|--------------------------------------------|--------------------|------|-----------------------|-------------------|--------------------------|-----------------|----------------------------|-----------------------|-----------------|--|--|--|
| FILE    SYSDATA (CREATION DATE = 11/25/83) |                    |      |                       |                   |                          |                 |                            |                       |                 |  |  |  |
| ----- T-TEST -----                         |                    |      |                       |                   |                          |                 |                            |                       |                 |  |  |  |
| GROUP 1 - GRADUATES                        |                    |      |                       |                   |                          |                 |                            |                       |                 |  |  |  |
| GROUP 2 - EMPLOYERS                        |                    |      |                       |                   |                          |                 |                            |                       |                 |  |  |  |
| VARIABLE                                   | NUMBER<br>OF CASES | MEAN | STANDARD<br>DEVIATION | STANDARD<br>ERROR | POOLED VARIANCE ESTIMATE |                 | SEPARATE VARIANCE ESTIMATE |                       |                 |  |  |  |
|                                            |                    |      |                       |                   | T<br>VALUE               | 2-TAIL<br>PROB. | T<br>VALUE                 | DEGREES OF<br>FREEDOM | 2-TAIL<br>PROB. |  |  |  |
| EXAMINATION REQUIREMENT                    |                    |      |                       |                   |                          |                 |                            |                       |                 |  |  |  |
| GROUP 1                                    |                    |      |                       |                   |                          |                 |                            |                       |                 |  |  |  |
| GROUP 2                                    |                    |      |                       |                   |                          |                 |                            |                       |                 |  |  |  |
| WORK PLACE REQUIREMENT                     |                    |      |                       |                   |                          |                 |                            |                       |                 |  |  |  |
| GROUP 1                                    |                    |      |                       |                   |                          |                 |                            |                       |                 |  |  |  |
| GROUP 2                                    |                    |      |                       |                   |                          |                 |                            |                       |                 |  |  |  |

Through the above illustration tables, the author feels that it is possible to obtain numerous frequency distribution tables, cross-tabulations or correlation analysis which will be useful in revising the educational programs, Syllabus of Studies and C.S.L.T. examinations to more adequately reflect the needs of the new graduate and employer.



## CHAPTER 5

### RECOMMENDATIONS, CONCLUSIONS AND SUMMARY

This study has resulted in numerous significant recommendations that should be implemented or further studied by the C.S.L.T. These recommendations are classified under three headings.

A. Primary recommendations: This category would include those recommendations based directly on the information and data collected during this study.

B. Related recommendations: Although not based specifically on the information and data gathered in this study, these recommendations are noteworthy and based on the observations and personal experiences of the author who has been intimately involved in medical laboratory technology in Canada for over twenty years. During this time, the author has worked as a general technologist, charge technologist, supervisor of laboratories and co-ordinator of training program and has been a member of the Board of Directors of the C.S.L.T. for six years as well as President of the Alberta Society of Medical Laboratory Technologists



(ASMLT) and the Canadian Society of Laboratory Technologists.

C. Recommendations for further study: These recommendations are presented as follow-up to this study, the extensive literature review and the initial findings of the study.

A. Primary Recommendations:

Recommendation #1

Competency in the language of instruction, English or French, should be compulsory for admission into all programs of medical laboratory technology in Canada. In addition, foreign students for whom English is a second language, should be required to successfully complete a TOEFL examination or equivalent test for English competency.

Good communication skills, spoken and written, are essential elements in the medical profession constantly dealing with life and death situations. Foreign students for whom English is a second language, gravitate to the medical pro-



fession, particularly medical laboratory technology and major problems associated with language competency and communication skills continue to plague these students at examination time and in the work place.

## Recommendation #2

The didactic segment of all training programs should be a minimum of two years.

The needs assessment survey shows that over one-third of all training program heads feel that the time spent in the didactic segment is not sufficient to teach/learn the core content and practical competencies. This is a significant finding and confirms the author's contention that a two year didactic component should be compulsory.

In addition, the increased time would allow for one general science year to include some optional courses such as English/French, communications and psychology as well as 25% introductory courses in medical laboratory technology. The second didactic year would be dedicated exclusively to the theoretical aspects





of the profession. This arrangement should create a better teaching/learning atmosphere and should produce a more rounded curriculum.

**Recommendation #3:**

The clinical segment of the program should not be conducted exclusively/primarily by simulation.

Although simulation has its place in the educational process, it should not be used as the clinical setting for practical instruction in medical laboratory technology. There are many important learning experiences such as stat situations, irate doctors/nurses, unrealistic work load demands and the health care team concept that cannot be simulated properly in a classroom setting.

**Recommendation #4:**

The Syllabus of Studies must continue to remain relevant through a proper validation process in the work place to ensure it is meeting the needs of the graduates and the employers.



Almost one-half of the program heads surveyed felt that the Syllabus of Studies does not contain the essentials for employment and that it contains a great deal of non-essential requirements. This is a significant finding and indicates the need to follow through with a graduate and employer survey to determine the actual needs in the work place. This study includes the design of appropriate questionnaires for this purpose. These questionnaires also attempt to validate the significant conclusions from the needs assessment survey by including pertinent questions regarding admission requirements and program structure.

#### B. Related Recommendations:

##### Recommendation #1:

The author would recommend the adoption of the following additional admission requirements taken from Table 4:

- a) medical examination including appropriate immunization for medical laboratory technologists.
- b) tour of clinical laboratory facility
- c) personal interview or references



Although not tested in this study, the author's personal experience as an educator indicates that most student applicants lack sufficient familiarity with the profession to make a career choice. In addition, T.V. medical shows such as Quincy present an unrealistic view of the world of the medical laboratory technologist and produce unattainable "visions of grandeur" in the viewer. A properly conducted tour and personal interview would help to dispel such notions and put the profession into perspective.

#### Recommendation #2:

A national study should be conducted to determine the feasibility and implications of requiring a compulsory two year didactic segment for each training program.

In light of the present educational and health care budget constraints and various philosophies regarding the role of the technical institutes and community colleges, this recommendation may not be readily supported by provincial governments and funding agencies. The need and importance of this change will have to be effectively and forcefully presented.



### Recommendation #3:

The skills best learned in a clinical laboratory environment as presented in Table 7 should be reviewed and implemented by each individual clinical teaching facility.

Since these skills are deemed essential in the work place, they should be emphasized in theory and practice during the clinical year in the hospital.

### Recommendation #4:

The Canadian Medical Association should re-evaluate its role in the accreditation of health care programs and take the necessary steps to effectively enforce established standards of practice and guidelines for professional certification.

As stated previously, the author believes that a process evaluation by accreditation is effective and appropriate for occupational/professional training programs. At the same time, the author contends that this process could be even more effective and meaningful with certain modifica-





tions and appropriate changes.

One fundamental concern with the accreditation process is that it appears that an accreditation team has no clout OR refuses to use its clout and authority to effectively force necessary changes to correct deficiencies in various training programs, particularly in medical laboratory technology. Each individual committee or team seems to hesitate to cite MAJOR problems within its report (a MAJOR problem could mean the withdrawal of full accreditation until steps have been taken to remedy the situation) and, for this reason, many serious deficiencies continue to exist that weaken the overall system of accreditation and certification. Examples of program deficiencies that continue to be glossed over are:

- (1) the variation in training time spent in the didactic and clinical segments of each program
- (2) the variation in scheduled rotational time spent in each major discipline during the clinical segment of each program, particularly the major disciplines of histotechnology and immunohematology



- (3) major changes in government commitment to the educational training of health care workers
- (4) detrimental effects of staff cuts and budget restrictions

**Recommendation #5:**

The Conjoint Committee on Accreditation should consider the feasibility and advantages of combining various aspects of the adversary model with the accreditation model for process evaluation of health care training programs.

It is the view of the author that this suggestion could result in greater introspection and participation by the total educational milieu - institutional administrators, didactic and clinical instructors, and students. An advocate and adversary group so formed from the above representatives, would present the strengths and weaknesses of the program to the panel, the accreditation team. It would call for an honest appraisal of all aspects of the training program without fear of censorship or reprisal at a later date.



## Recommendation #6

The C.M.A. should consider the feasibility of establishing permanent regional accreditation teams to conduct on-site inspections of training programs.

Accreditation calls for an in-depth on-site inspection of all aspects of a training program. This cannot be done adequately in a few hours. It has been the author's experience that most inspection teams spend no more than one day evaluating an entire University program including didactic and clinical segments, instructional staff, facilities, and resources.

The author recognizes that accreditation teams are composed of volunteers from the various professional organizations and that these individuals cannot be released from their professional duties for an extended period of time. However, if the C.M.A. and the professional organizations truly believe in the need and value of accreditation, they must consider other alternatives in the composition of accreditation teams that would allow adequate time for the necessary in-depth study.



### Recommendation #7

The C.S.L.T. should adopt a similar policy to the American Society of Clinical Pathologists (A.S.C.P.) regarding the actual distribution of copies of certification examinations.

The A.S.C.P. refuses to release copies of its M.T. certification examinations to any educational institute or interested individual. However, it does circulate numerous examples of question format and weighting guidelines to assist students and instructors in preparing for such examinations.

### Recommendation #8:

The C.S.L.T. should re-evaluate its present examination emphasis, format and structure to determine if they are valid, reliable and relevant.

Although not part of this study, many concerns regarding the present examination process and subsequent results have surfaced during this investigation. The author would strongly recommend the services of an educational research





centre such as the McLaughlin Examination and Research Centre in Edmonton to conduct an extensive evaluation of the present multiple-choice certification examinations. This evaluation would include an ITEM ANALYSIS, the evaluation of each item and how it was answered, to indicate the difficulty and discrimination indices and the effectiveness of the distractors. The information obtained from this analysis should be used by the examination panels to improve the certification examinations.

#### Recommendations for Further Study:

##### Recommendation #1:

To support primary recommendation #1 regarding language competency and communication skills, a national comparative study should be conducted to determine any significant differences in success rates on R.T. certification examinations between students WITH/WITHOUT English/ French.

##### Recommendation #2:

Similarly, to support primary recommendation #2 regarding a compulsory two year didactic seg-



ment, the following comparative studies should be conducted:

- (1) attrition and failure rates in one year vs. two year didactic training programs
- (2) R.T. examination results between one year vs. two year didactic training programs

#### Further Conclusions:

As stated previously, the distribution, collection and interpretation of the follow-up and employer surveys is beyond the scope of this study. However, the analysis from these studies should adequately respond to the concerns and research questions posed at the beginning of this study:

##### a) Antecedents (inputs):

- (i) the changes and revisions required in the Syllabus of Studies to meet the needs of the new graduate and the prospective employers
- (ii) the ability of the present training programs to teach the essential theoretical knowledge and practical skills in the allotted time frame of 20-24 months



- (iii) the skills best learned in the clinical laboratory environment

**b) Product (outputs):**

The analysis and comparison of the responses from the graduates and prospective employers should establish answers and recommendations regarding:

- (i) the actual competencies and essential skills required by the new graduate and the work place today
- (ii) the disciplines that should continue to be included in the general R.T. certification programs
- (iii) the body of knowledge considered essential for the general certification program

**Summary**

The evaluation model designed in this study to evaluate the national certification program in medical laboratory technology in Canada is an appropriate model for the evaluation of any professional/technical program.

Specifically built on Stufflebeam's CIPP model, it is unique in its total integration approach to the evaluation



of a training program. For this reason, it could also be classified as a Systems Theory approach to evaluation since it includes all aspects of the program (inputs, thruputs and outputs) and all groups directly or indirectly involved in the actual training of medical laboratory technologists (medical profession, professional organization, training institutions, graduates and prospective employers).





## GLOSSARY OF MEDICAL TERMS

**Biochemistry (clinical chemistry)** - the study of chemical reactions occurring in living organisms.

**Hematology** - the science dealing with the study of blood and its diseases.

**Histology (histotechnology)** - microscopic study of the form and structure of the various tissues making up living organisms.

**Immunohematology (blood banking)** - typing, processing, and storing of blood.

**Microbiology (bacteriology)** - the study of minute living organisms including bacteriology, molds, and pathogenic protozoa.

**Immunology** - the scientific study of immunity.

**Parasitology** - the scientific study of parasites.

**Serology** - the study of antigen-antibody reactions in vitro.



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APPENDIX A

APPROVED TRAINING PROGRAMS  
FOR MEDICAL LABORATORY TECHNOLOGY  
IN CANADA



MEDICAL LABORATORY TRAINING PROGRAMS IN CANADA

Newfoundland

College of Trades and Technology  
Medical Sciences Department  
Topsail Campus, Topsail Road  
ST. JOHN'S, Newfoundland  
A1C 5P7

New Brunswick

New Brunswick School of Medical Technology  
Saint John Campus, Granview Avenue  
SAINT JOHN, New Brunswick  
E2L 3V1

Prince Edward Island

Students from P.E.I. take the academic phase of  
their training at the Nova Scotia Institute of Technology

Nova Scotia

Nova Scotia Institute of Technology  
5685 Leeds Street  
HALIFAX, Nova Scotia  
B3K 2T3

British Columbia

Cariboo College  
900 McGill Street  
KAMLOOPS, B.C.  
V2C 5N3

British Columbia Institute of Technology  
3700 Willingdon Avenue  
VANCOUVER, B.C.  
V5C 3H2





Quebec

CEGEP de Rimouski  
66 ouest rue Evêché  
RIMOUSKI, P.Q.

CEGEP de Chicoutimi  
534 Est Rue Jacque-Cartier  
CHICOUTIMI, P.Q.  
G7H 1Z5

CEGEP de Ste-Foy  
2410 Chemin Ste-Foy  
Ste. Foy, P.Q.  
G1V 1T3

CEGEP de Sherbrooke  
475 Rue Parc  
SHERBROOK, P.Q.  
J1H 5M7

CEGEP de Shawinigan  
972 Ste. Ursule  
Trois-Rivieres, P.Q.  
G9A 1P1

CEGEP de Rosemont  
6400 - 16<sup>ème</sup> Avenue  
ROSEMONT, P.Q.  
H1X 2S9

Dawson College  
350 Selby Street  
MONTREAL, P.Q.  
H3Z 1W7

CEGEP de Saint-Jérôme  
455 Rue Fournier  
ST. JEROME, P.Q.  
J7Z 4V2

CEGEP de St. Jean  
30 Boulevard De Seminaire  
ST. JEAN, P.Q.  
J3B 5J4

Ontario

Algonquin College, Rideau Campus  
200 Lees Avenue  
OTTAWA, Ontario  
K1S 5B8

St. Lawrence College  
King St. W. & Portsmouth Avenue  
KINGSTON, Ontario  
K7L 5A6

Hotel Dieu Hospital  
155 Ontario Street  
ST. CATHERINE, Ontario  
L2R 5K3

Toronto Institute of Medical Technology  
222 St. Patrick Street  
TORONTO, Ontario  
M5T 1V4

Canadore College  
1300 Gormanville Road  
NORTH BAY, Ontario  
P1B 8K9

Mohawk College  
Medical Laboratory Division  
Chedoke Campus  
P.O. Box 2034  
HAMILTON, Ontario  
L8N 3T2

Cambrian College  
885 Regent Street South  
SUDBURY, Ontario  
P3E 4T2

Fanshawe College  
P.O. Box 4005, Oxford Street E.  
LONDON, Ontario  
N5W 5H1



Lambton College  
London Road  
P.O. Box 969  
SARNIA, Ontario  
N7T 7K4

St. Clair College  
2000 Talbot Road West  
WINDSOR, Ontario  
N9A 6S4

Thunder Bay Institute of  
Medical Technology  
McKellar General Hospital  
325 S. Archibald Street  
THUNDER BAY, Ontario  
P7E 1G6

#### Manitoba

Red River Community College  
Room #A325  
2055 Notre Dame Avenue  
WINNIPEG, Manitoba  
R3H 0J9

#### Saskatchewan

Kelsey Institute  
Idylwyld Drive & 33rd Street  
P.O. Box 1520  
SASKATOON, Saskatchewan  
S7K 3R5

Medical Laboratory Technology  
University of Regina  
REGINA, Saskatchewan  
S4S 0A2

#### Alberta

Northern Alberta Institute  
of Technology  
11762 - 106 Street  
EDMONTON, Alberta  
T5G 2R1

Southern Alberta Institute  
of Technology  
1301 - 16th Avenue, N.W.  
CALGARY, Alberta  
T2M 0L3

University of Alberta  
Medical Laboratory Science  
B-117 Clinical Sciences Building  
EDMONTON, Alberta  
T6E 2G3



APPENDIX B

ONTARIO DEPARTMENT OF EDUCATION

DACUM CHART

MEDICAL LABORATORY TECHNOLOGY PROGRAM



GENERAL AREAS OF COMPETENCE

- |    |                                                    |
|----|----------------------------------------------------|
| 01 | Collect samples                                    |
| 02 | Perform Laboratory Tests                           |
| 03 | Maintain quality control                           |
| 04 | Operate and maintain instruments                   |
| 05 | Maintain supplies                                  |
| 05 | Prepare laboratory materials                       |
| 07 | Maintain safe environment                          |
| 08 | Maintain records                                   |
| 09 | Work as a member of the health care team           |
| 10 | Evaluate methods and procedures                    |
| 11 | Teach students and members of the health care team |





GENERAL AREAS OF COMPETENCIES

INDIVIDUAL SKILLS

|                                     |                                                                     |                                          |                                            |
|-------------------------------------|---------------------------------------------------------------------|------------------------------------------|--------------------------------------------|
| 10. EVALUATE METHODS AND PROCEDURES | PURSUE INFORMATION OF NEW METHODS AND PROCEDURES                    | ASSESS RELATIVE EFFICIENCY OF METHODS    | ASSESS IMPACT OF METHOD ON PATIENT COMFORT |
|                                     | ASSESS RELATIVE PRECISION AND ACCURACY AMONG METHODS AND PROCEDURES | ASSESS SAFETY OF METHODS AND PROCEDURES  | IDENTIFY PROBLEMS WITH TECHNIQUE           |
|                                     | RECOMMEND CHANGES FOR IMPROVEMENT OF METHODS OR PROCEDURES          | INITIATE APPROVED METHODS AND PROCEDURES |                                            |



GENERAL AREAS OF COMPETENCIES

11. TEACH STUDENTS AND  
MEMBERS OF THE HEALTH  
CARE TEAM

LIAISE WITH OTHERS IN  
PREPARING SCHEDULES  
OF ROTATION FOR  
STUDENTS

EXPLAIN AND DEMONSTRATE  
TECHNIQUE

ASSIST IN ORIENTATION  
OF NEW STAFF AND  
STUDENTS

ATTEND IN-SERVICE  
PROGRAMS

INDIVIDUAL SKILLS

ASSIST WITH THE DESIGN  
OF STUDENT PROJECTS,  
ASSIGNMENTS AND TESTS

ASSIST STUDENT IN  
RESOLVING PROBLEMS

LIAISE WITH COLLEGES

LECTURE STUDENTS

EVALUATE STUDENT AND  
PEER PERFORMANCE

ARRANGE IN-SERVICE  
PROGRAMS



GENERAL AREAS OF COMPETENCIES

INDIVIDUAL SKILLS

09. WORK AS A MEMBER OF THE HEALTH CARE TEAM

MAINTAIN PROFESSIONAL ETHICS AND CONDUCT

MAINTAIN PROFESSIONAL CONDUCT IN STRESSFUL SITUATIONS  
e.g. CHILD DYING

ADVISE OTHERS OF LABORATORY SERVICES AND ASSOCIATED PROTOCOL

DISCUSS MUTUAL PROBLEMS WITH MEMBERS OF HEALTH CARE TEAM

LIATSE WITH OTHER DEPARTMENTS AND INSTITUTIONS

RESOLVE CONFLICT CONSTRUCTIVELY

CONSULT OTHERS

RESPOND TO ENQUIRIES

QUESTION IMPROBABLE AND INAPPROPRIATE REQUESTS



# GENERAL AREAS OF COMPETENCIES

|                      |                                                                       |                                                                    |                                                                                  |
|----------------------|-----------------------------------------------------------------------|--------------------------------------------------------------------|----------------------------------------------------------------------------------|
| 08. MAINTAIN RECORDS | RECORD MAINTENANCE<br>PERFORMED ON EQUIPMENT                          | PREPARE, RECORD, FILE<br>AND ACCESS STAFF WORK<br>SCHEDULES        | PREPARE, UPDATE AND<br>ASSESS LIST OF PEPs-<br>ONNEL FOR EMERGENCY<br>CALL BACKS |
|                      | PREPARE, UPDATE AND<br>ACCESS FILE OF SUPPLIERS                       | PREPARE, UPDATE, FILE<br>AND ACCESS STUDENT<br>PERFORMANCE RECORDS | FILE TEMPERATURE<br>CHARTS                                                       |
|                      | PREPARE, FILE, UPDATE AND<br>ACCESS FILE ON REFERENCE<br>INSTITUTIONS | UPDATE, FILE AND ACCESS<br>BLOODRANK REFERENCE<br>FILES            | RECORD AND FILE<br>COMMUNICATIONS WITH<br>OTHER MEMBERS OF<br>HEALTH CARE TEAM   |
|                      | FILE AND ACCESS QUALITY<br>CONTROL RESULTS                            | PREPARE, UPDATE, FILE<br>AND ACCESS PATIENT IN-<br>LAB FILES       | ENSURE DELIVERY OF<br>LAB TEST REPORTS<br>FOR CHARTING                           |
|                      | PREPARE, UPDATE AND ACCESS<br>METHOD AND PROCEDURE<br>MANUAL          | PREPARE, FILE AND ACCESS<br>WORKSHEETS                             | COUNT & REPORT<br>D.B.S. UNITS<br>(DAILY & MONTHLY)                              |
|                      | PREPARE MONTHLY REPORTS<br>FOR "RED CROSS"                            |                                                                    |                                                                                  |





# GENERAL AREAS OF COMPETENCIES

## INDIVIDUAL SKILLS

|                                               |                                                        |                                                                    |                                           |
|-----------------------------------------------|--------------------------------------------------------|--------------------------------------------------------------------|-------------------------------------------|
| 07. MAINTAIN SAFE ENVIRONMENT                 | OBSERVE THE SAFETY REGULATIONS OF THE INSTITUTION      | USE CORRECT PROCEDURES AND EQUIPMENT FOR SAFE HANDLING OF SPECIMEN | MAINTAIN LABORATORY HYGIENE PRACTICES     |
| REPORT ACCIDENTS AND PREPARE INCIDENT REPORTS | OPERATE AND MAINTAIN SAFETY EQUIPMENT<br>e.g. EYEBATHS | LABEL HAZARDOUS MATERIALS APPROPRIATELY                            | IDENTIFY AND CORRECT HAZARDOUS SITUATIONS |
| STORE HAZARDOUS MATERIALS PROPERLY            | PERFORM BASIC FIRST AID AND INITIATE C.P.R.            | SELECT AND USE CORRECT AGENTS AND PROCEDURES FOR DECONTAMINATION   |                                           |
| FOLLOW CORRECT DISPOSAL PROCEDURES            |                                                        |                                                                    |                                           |



GENERAL AREAS OF COMPETENCIES

06. PREPARE LABORATORY  
MATERIALS

INDIVIDUAL SKILLS

CLEAN AND/OR STERILIZE  
EQUIPMENT

CALCULATE QUANTITIES USING  
FORMULAE AND EQUATIONS

MEASURE QUANTITIES  
USING VOLUMETRIC  
EQUIPMENT

MEASURE QUANTITIES  
USING BALANCES

COMBINE MATERIALS USING  
APPROPRIATE PROCEDURES  
AND TECHNIQUES

MEASURE pH  
(INDICATORS & METERS)

DISPENSE AND LABEL  
PREPARED MATERIALS

STORE PREPARED MATERIALS  
APPROPRIATELY



GENERAL AREA OF COMPETENCIES

05. MAINTAIN SUPPLIES

INDIVIDUAL SKILLS

TAKE AND MAINTAIN  
INVENTORY

CHECK LOT NUMBERS  
AND EXPIRY DATE REAGENTS

REPORT UNSUITABLE  
SUPPLIERS TO SUPERVISOR

RETURN UNSUITABLE  
SUPPLIES

ROTATE SUPPLIERS

DISPOSE OF OUTDATED  
STOCK

PROVIDE SUPPLIERS TO  
WARD

EXCHANGE SUPPLIES WITH  
OTHER LABORATORIES



GENERAL AREAS OF COMPETENCIES

04. OPERATE AND MAINTAIN  
INSTRUMENTS

INDIVIDUAL SKILLS

|                                                         |                                  |                                        |
|---------------------------------------------------------|----------------------------------|----------------------------------------|
| PERFORM ROUTINE BASIC<br>MAINTENANCE OF<br>INSTRUMENTS  | OPERATE MIXERS                   | OPERATE DISCRETE<br>ANALYZERS          |
| OPERATE CONTINUOUS<br>FLOW INSTRUMENTS                  | OPERATE pH METERS                | OPERATE ELECTROPHORETIC<br>INSTRUMENTS |
| MONITOR REFRIGERATORS,<br>INCUBATORS AND WATER<br>BATHS | OPERATE LIGHT<br>MICROSCOPES     | OPERATE MICROSCOPES                    |
| OPERATE STERILIZING<br>INSTRUMENTS                      | OPERATE DILUTORS                 | OPERATE STAINING<br>DEVICES            |
| OPERATE OSMOMETERS                                      | OPERATE GAS<br>CHROMATOGRAPHS    | OPERATE FLUOROMETERS                   |
| OPERATE ATOMIC ABSORP-<br>TION INSTRUMENTS              | OPERATE BLOOD-GAS<br>INSTRUMENTS | OPERATE CHLORIDOMETERS                 |





GENERAL AREAS OF COMPETENCIES

01. COLLECT SAMPLES

SELECT APPROPRIATE  
COLLECTION EQUIPMENT

CONFIRM IDENTITY  
OF PATIENT

COLLECT SPECIMEN

INITIATE APPROPRIATE  
PROCEDURE IF PATIENT  
IS IN DISTRESS

PREPARE SPECIMEN FOR  
BENCH TEST, STORAGE OR  
REFERRAL

INDIVIDUAL SKILLS

LOCATE PATIENT

GAIN PATIENT'S  
PERMISSION

IDENTIFY SAMPLE

TRANSPORT SPECIMEN  
TO LAB

LOG OUT REFERRED  
SPECIMEN

EMPLOY ISOLATION  
TECHNIQUES WHEN  
NECESSARY

PREPARE PATIENT FOR  
COLLECTION

CHECK PATIENT FOR  
DISTRESS

LOG IN SPECIMEN

MAKE SPECIAL SHIPPING  
ARRANGEMENTS IF  
NECESSARY



# GENERAL AREAS OF COMPETENCIES

## INDIVIDUAL SKILLS

|                              |                                                    |                                                       |                                                                |
|------------------------------|----------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------------|
| 02. Perform Laboratory Tests | CHECK SPECIMEN IDENTIFICATION                      | DECIDE SUITABILITY OF SPECIMEN FOR REQUIRED TEST      | SELECT PROCEDURE(S) APPROPRIATE TO SPECIMEN AND TESTS REQUIRED |
|                              | ORGANIZE WORKSHEET                                 | ORGANIZE TIME TO SUIT WORKLOAD                        | PERFORM LABORATORY EVALUATIONS (SEE APPENDICES)                |
|                              | CONSTRUCT, READ AND INTERPRET GRAPHS AND CHARTS    | PERFORM NECESSARY CALCULATIONS                        | EVALUATE TEST RESULTS                                          |
|                              | CORRELATE TEST RESULT WITH PREVIOUS AND OTHER TEST | IDENTIFY ABNORMALITIES AND/OR CONDUCT FOLLOW-UP TESTS | INITIATE APPROPRIATE FOLLOW-UP PROCEDURE                       |
|                              | REPORT RESULTS                                     | RETAIN SPECIMEN FOR CONFIRMATION TESTING OR RETESTING | DISPOSE OF WASTE MATERIALS                                     |
|                              | CLEAN-UP WORKSPACE                                 |                                                       |                                                                |
|                              |                                                    |                                                       |                                                                |
|                              |                                                    |                                                       |                                                                |



GENERAL AREAS OF COMPETENCIES

INDIVIDUAL SKILLS

|                              |                                                                   |                                                              |                                                        |
|------------------------------|-------------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------|
| 03. MAINTAIN QUALITY CONTROL | CALIBRATE AND STANDARD-<br>IZE EQUIPMENT ON ROUT-<br>INE SCHEDULE | MONITOR FUMEHOODS AND<br>SAFETY EQUIPMENT                    | MONITOR REFRIGERATORS<br>INCUBATORS AND WATER<br>BATHS |
|                              | MONITOR EFFICIENCY OF<br>STERILIZATION PROCEDURES                 | CHECK ALL INCOMING<br>SUPPLIES                               | TEST ALL INCOMING<br>SUPPLIES                          |
|                              | TEST REAGENTS AND<br>MATERIALS FOR<br>ACCEPTABILITY               | RUN CONTROL AND/OR<br>STANDARDS WITH EVERY<br>TEST PERFORMED | RECORD AND EVALUATE<br>QUALITY CONTROL RESULTS         |
|                              | EVALUATE ASSESSMENT<br>OF EXTERNAL PROFICIENCY<br>TESTING         |                                                              |                                                        |



GENERAL AREAS OF COMPETENCIES

OPERATE AND MAINTAIN  
04. INSTRUMENTS (CON'T)

INDIVIDUAL SKILLS

OPERATE FLAME  
PHOTOMETERS

OPERATE SPECTROPHOTO-  
METERS

OPERATE REFRACTOMETERS

OPERATE HAEMOGLOBINOMETER

OPERATE AUTOMATED CELL  
COUNTERS

OPERATE AUTOMATIC  
PLATE POURERS

OPERATE CELL WASHERS

OPERATE MINI COMPUTERS

USE BENCH AND PROGRAM-  
MABLE CALCULATORS

OPERATE BALANCES

OPERATE TISSUE PROCESSORS

OPERATE MICROTOME  
KNIFE SHARPENERS

OPERATE MICROTOMES

OPERATE CRYOSTATS

OPERATE STILLIS AND  
DE-IONIZERS

OPERATE AND FUME HOODS

OPERATE AUTOMATIC  
GLASSWARE WASHER

IDENTIFY INSTRUMENT  
PROBLEMS





APPENDIX C

NORTHERN ALBERTA INSTITUTE OF TECHNOLOGY

DACUM CHART

MEDICAL LABORATORY PROGRAM



GENERAL AREAS OF COMPETENCE

- A. Communicate effectively in the work environment
- B. Apply laboratory safety and emergency procedures
- C. Prepare reagents and standards
- D. Collect and prepare specimens
- E. Report and maintain records
- F. Maintain quality control
- G. Perform manual techniques
- H. Perform automated techniques
- I. Maintain and troubleshoot equipment and instruments
- J. Supervise, administer, and organize
- K. Perform specialized techniques



## GENERAL AREA OF COMPETENCE

### A. COMMUNICATE EFFECTIVELY IN THE WORK ENVIRONMENT

#### INDIVIDUAL SKILLS

1. Write legibly
2. Work as part of a team
3. Accept constructive criticism
4. Deal professionally with patients
5. Use technical terminology
6. Use proper telephone and intercome techniques
7. Write letters
8. Use medical terminology
9. Utilize medical and technical research facilities (i.e. library)
10. Maintain liaison with other hospital departments
11. Request and obtain information and decisions
12. Participate in seminars and workshops
13. Present reports, evaluations, and problems at meetings
14. Recognize and question unreasonable orders
15. Explain why lab cannot comply with requests
16. Explain lab policies, procedures or changes
17. Give clear work instructions
18. Give constructive criticism
19. Advise and educate hospital staff on laboratory utilization
20. Organize and conduct meetings
21. Conduct seminars and lectures
22. Maintain and distribute minutes of meetings
23. Compile and maintain laboratory and ward manuals
24. Reason with administration



## GENERAL AREA OF COMPETENCE

### B. APPLY LAB. SAFETY AND EMERGENCY PROCEDURES

#### INDIVIDUAL SKILLS

1. Clean up non hazardous spills
2. Recognize need for and use protective clothing and equipment
3. Observe health, safety, and fire regulations
4. Replace damaged or soiled requisitions
5. Double-check labelling before using reagents
6. Recognize need for and use fume hood
7. Recognize potential physical hazards in lab
8. Use open flames
9. Locate all emergency equipment
10. Prevent aerosols
11. Handle microtome knives
12. Maintain clean and orderly work and storage areas
13. Clean up and dispose of broken glassware and shards
14. Handle and dispose of specimens and reagents
15. Handle and dispose of contaminated materials
16. Disinfect work areas and equipment
17. Label hazardous material using appropriate symbols
18. Operate emergency showers and eye wash
19. Use fire blanket
20. Use suitable fire extinguishers
21. Mix potentially dangerous reagents and chemicals
22. Recognize, handle, and store flammable liquids
23. Recognize, store, and handle dangerous acids and alkalis
24. Recognize, store, and control hazardous drugs and narcotics
25. Recognize, handle, and store explosives
26. Recognize, store, and handle carcinogens
27. Handle, store, and dispose of gas cylinders
28. Handle ultra cold material
29. Follow lab accident procedures
30. Apply first aid
31. Function in emergency situations in all departments
32. Recognize high risk areas
33. Recognize hazardous conditions in electrical equipment
34. Designate high risk areas and materials
35. Protect self from radiation
36. Monitor bench areas for radioactivity
37. Dispose of radioactive materials to gov't specifications
38. Monitor personnel for radioactivity





## GENERAL AREA OF COMPETENCE

### C. PREPARE REAGENTS AND STANDARDS

#### INDIVIDUAL SKILLS

1. Label
2. Select appropriate containers
3. Follow recipes and instructions
4. Clean glassware
5. Mix
6. Filter
7. Measure by volume
8. Use top-loading balance
9. Use analytical balance
10. Prepare dilutions
11. Operate pH meters
12. Titrate
13. Use heat correctly
14. Calculate and use appropriate formulae
15. Store reagents and standards
16. Grind with mortar and pestle
17. Sterilize
18. Check and discard outdated reagents and chemical
19. Select reagent quality according to method requirements
20. Check out prepared reagents
21. Dessicate reagents
22. Calibrate secondary standards vs primary standards
23. Calibrate volumetric glassware
24. Check conductivity of water
25. Purify water by distillation, filtration, and deionization
26. Establish and maintain log of reagents prepared



## GENERAL AREA OF COMPETENCE

### D. COLLECT AND PREPARE SPECIMENS

#### INDIVIDUAL SKILLS

1. Label specimens
2. Protect self and patient by using isolation techniques
3. Follow aseptic technique
4. Follow patient identification procedures
5. Reassure patients
6. Select proper containers for specimen collection
7. Choose and prepare site for specimen collection
8. Choose proper needle gauge
9. Perform venipunctures using vacuum tubes
10. Collect specimens in proper sequence
11. Perform venipunctures using syringe
12. Perform double syringe technique
13. Collect capillary specimens
14. Match and number tubes and requisitions
15. Prepare and cover slip films
16. Handle and transport specimens
17. Prepare urine sediment for microscopic examination
18. Centrifuge and aliquot specimens
19. Decontaminate specimen containers
20. Balance and operate centrifuge
21. Mix, measure volume, and aliquot specimens
22. Defibrinate blood
23. Mix, weigh, and aliquot specimens
24. Recognize and report insufficient specimen or improper collection
25. Recognize specimen type
26. Determine appropriate amount of specimen required for test
27. Maintain accession and filing system
28. Recognize normal and abnormal specimens (i.e. appearance)
29. Store specimens
30. Record, pack, and ship out specimens
31. Prepare specimen containers for special collections
32. Use butterfly technique
33. Prepare blood films



## GENERAL AREA OF COMPETENCE

### E. REPORT AND MAINTAIN RECORDS

#### INDIVIDUAL SKILLS

1. Write legibly
2. Control confidentiality of reports and reporting
3. Maintain accession system
4. Maintain accurate log of referred-out specimens and results
5. Maintain daily working records
6. Identify normal results
7. Report values in terms of concentration
8. Enter relevant information on reports
9. Report reference values
10. Complete requisitions
11. Provide oral explanations of results
12. Recognize errors in reporting
13. Detect procedure errors from test results
14. Recognize abnormal results
15. Recognize and investigate abnormal change in patient results
16. Relate results to clinical conditions
17. Relate results to patient history
18. Recognize needs and give preliminary reports
19. Dispatch report copies
20. Recognize and act on panic values
21. Explain why it is known that test results are correct
22. Report and receive explanations on telephone
23. Provide written explanations of results
24. Assess compatibility of results of different tests
25. Suggest possible follow-up procedures
26. Maintain follow-up on delayed values
27. Maintain filing system
28. Check reported values
29. Maintain unit values system
30. Maintain proper long term storage of lab records
31. Design and update requisition and report forms
32. Initiate and verify fee changes



## GENERAL AREA OF COMPETENCE

### F. MAINTAIN QUALITY CONTROL

#### INDIVIDUAL SKILLS

1. Read and follow instructions exactly
2. Examine glassware for cleanliness and suitability
3. Prepare standards, controls, and reagents
4. Assure integrity of specimens, controls, and reagents
5. Store reagents, specimens, standards, and quality control materials
6. Calculate mean and standard deviation
7. Recognize need for repeating tests
8. Establish reference values
9. Establish stability of standards, controls, and reagents
10. Recognize variables in tests in order to select controls
11. Compile cumulative data
12. Perform and record regular calibration checks on equipment
13. Maintain regular observation checks during equipment operation and use
14. Decide if results are reportable
15. Assess variables and determine frequency of controls
16. Perform sterility checks
17. Institute double-checking procedures
18. Use patient records as quality control indicator
19. Determine allowable limits of error
20. Recognize random errors
21. Locate random errors
22. Recognize systematic errors
23. Locate systematic errors
24. Record systematic errors
25. Check on accuracy and reproducibility of tests and controls
26. Evaluate accuracy and precision of method
27. Maintain equipment inventory
28. Interpret quality control results
29. Carry out recovery experiments
30. Co-ordinate quality control
31. Set up quality control program and manual
32. Select appropriate statistical tools
33. Prepare and maintain methods manual
34. Prepare and update maintenance manuals
35. Investigate methodological problems
36. Demonstrate unusual techniques and non typical specimens
37. Maintain specimen library





## GENERAL AREA OF COMPETENCE

### 6. PERFORM MANUAL TECHNIQUES

#### INDIVIDUAL SKILLS

1. Use timing devices
2. Follow instructions exactly
3. Use Pasteur pipettes
4. Use serological pipettes
5. Use magnifying lens
6. Use volumetric pipettes
7. Use Thoma pipette
8. Use Sahli pipette
9. Use capillary pipettes
10. Choose appropriate pipettes
11. Dilute specimens
12. Decant
13. Operate dilutors
14. Read thermometers
15. Use pH indicator paper
16. Make and fix smears on glass slides
17. Select and use heating and incubating equipment
18. Select and use cooling equipment
19. Select and use mixing equipment
20. Select and use hydrometers
21. Select and use centrifuge
22. Use the cytospin
23. Operate a spectrophotometer
24. Select and use proper glassware
25. Select, use, and care for cuvettes
26. Concentrate specimens
27. Perform serial dilutions
28. Select and use filtration equipment
29. Draw calibration curves & calculate unknowns
30. Use polarizing microscope
31. Select appropriate control slides
32. Recognize problems when they occur
33. Use Gram's stain
34. Screen nasal smears for eosinophils
35. Use Z-N stain
36. Select appropriate reagents
37. Perform hemocytometer stain
38. Choose appropriate diluting fluid
39. Read and grade agglutination
40. Use stereoscopic microscope
41. Perform agglutination techniques
42. Operate refractometer
43. Use light microscope
44. Combine simple skills to perform more complex methods
45. Use fluorescent microscope
46. Use darkfield microscope
47. Use phase contrast microscope
48. Operate spectroscope
49. Select and use distillation equipment
50. Perform extraction procedures
51. Perform end point reactions
52. Select and use indicators for end point titration
53. Perform plasma hemoglobin tests
54. Stain and verify histochemical procedures (e.g. P.A.S.)
55. Perform special stains (Sudan Black, NSE, B-Glucuronidase, acid phos., myeloperoxidase, ... malaria)
56. Perform agar electrophoresis
57. Prepare electrophoresis media
58. Recognize need for further testing
59. Recognize possible causes of false positive and false negative results
60. Perform functional tests on patients



GENERAL AREA OF COMPETENCE

## H. PERFORM AUTOMATED TECHNIQUES

INDIVIDUAL SKILLS

1. Operate automatic burettes
2. Operate automatic pipetters
3. Operate automatic dispensers
4. Log data from digital readouts
5. Operate semi-automatic titrators
6. Operate continuous flow instruments
7. Identify, read, and log peaks on recorder
8. Operate discrete analyzers
9. Operate recording spectrophotometer
10. Operate densitometers
11. Prepare specimens in sequence
12. Use computer facilities
13. Operate automated slide makers
14. Operate automated R.I.A. systems
15. Operate small computers



## GENERAL AREA OF COMPETENCE

### I. MAINTAIN AND TROUBLESHOOT EQUIPMENT AND INSTRUMENTS

#### INDIVIDUAL SKILLS

- |                                                       |                                                                            |
|-------------------------------------------------------|----------------------------------------------------------------------------|
| 1. Follow manufacturer's instructions for maintenance | 25. Clean and/or replace tubing                                            |
| 2. Wash glassware according to method requirements    | 26. Maintain slide stainers                                                |
| 3. Log equipment maintenance                          | 27. Adjust and maintain automated cell washers                             |
| 4. Keep instruments and equipment clean               | 28. Clean and service air compression and vacuum pumps                     |
| 5. Check and change dessicants                        | 29. Maintain constant monitoring devices of refrigerators and freezers     |
| 6. Match cuvettes                                     | 30. Maintain automated slide maker                                         |
| 7. Check and clean glass pipettes                     | 31. Change dialysis membranes                                              |
| 8. Check calibration of balances                      | 32. Lubricate pumps, motors, and other moving parts                        |
| 9. Check and clean filters                            | 33. Clean and service pumps on pinetting station                           |
| 10. Replace light sources                             | 34. Replace valves, and other parts in equipment                           |
| 11. Replace gas cylinders                             | 35. Perform electronic checks                                              |
| 12. Check and change deionizing resins                | 36. Check and calibrate refractometers                                     |
| 13. Maintain heating and cooling baths                | 37. Monitor background counts on counters (cell & isotope)                 |
| 14. Check and adjust temperature regulating equipment | 38. Calibrate colorimeters                                                 |
| 15. Check and/or change centrifuge brushes            | 39. Calibrate spectrophotometers                                           |
| 16. Check calibration of manual pipettes              | 40. Calibrate strip chart recorders                                        |
| 17. Maintain automatic pipettors                      | 41. Calibrate densitometers                                                |
| 18. Maintain automatic dilutors                       | 42. Check and adjust wavelengths                                           |
| 19. Calibrate automatic pipettors                     | 43. Adjust calibration of balances                                         |
| 20. Calibrate dilutors                                | 44. Establish threshold curve for calibration of counters (cell & isotope) |
| 21. Calibrate burettes                                | 45. Check calibration of counters                                          |
| 22. Clean water stills                                | 46. Follow manufacturer's troubleshooting guides                           |
| 23. Check calibration of timing devices               |                                                                            |
| 24. Determine and adjust aspiration rate              |                                                                            |



## GENERAL AREA OF COMPETENCE

### J. SUPERVISE, ADMINISTER, AND ORGANIZE

#### INDIVIDUAL SKILLS

- |                                                               |                                                                      |
|---------------------------------------------------------------|----------------------------------------------------------------------|
| 1. Keep time sheets                                           | 32. Evaluate and select new instruments and equipment                |
| 2. Accept responsibility                                      | 33. Accept or reject method under investigation                      |
| 3. Make up work schedules                                     | 34. Perform follow-up evaluations of newly introduced methods        |
| 4. Demonstrate efficient performance                          | 35. Conduct meetings                                                 |
| 5. Demonstrate methods                                        | 36. Liaise with other departments                                    |
| 6. Assign tasks                                               | 37. Give lectures and seminars                                       |
| 7. Delegate authority                                         | 38. Enforce staff health, fire and safety regulations and procedures |
| 8. Orient new staff                                           | 39. Interview and select staff                                       |
| 9. Recognize and deal with personnel problems                 | 40. Write and/or review job descriptions                             |
| 10. Discipline staff                                          | 41. Set objectives                                                   |
| 11. Evaluate staff members                                    | 42. Establish lab policies                                           |
| 12. Initiate disciplinary action                              | 43. Negotiate sales and service contracts                            |
| 13. Verify and sign completed reports                         | 44. Prepare budgets                                                  |
| 14. Organize bench work for efficiency                        | 45. Negotiate wages and service contracts                            |
| 15. Keep orderly log on procedure development                 | 46. Operate within labour relations codes and union contracts        |
| 16. Compile hospital units and statistics                     | 47. Establish unit values for tests                                  |
| 17. Budget efficiently                                        | 48. Initiate corrective action for lab and reordering errors         |
| 18. Review literature to evaluate new equipment and materials | 49. Analyze lab utilization and point out suspected abuses           |
| 19. Maintain quality control systems                          | 50. Develop Q.C. programs                                            |
| 20. Maintain record systems                                   | 51. Design evaluation studies                                        |
| 21. Order supplies                                            | 52. Establish training and continuing education programs             |
| 22. Maintain personnel records                                | 53. Monitor training programs                                        |
| 23. Develop inventory systems                                 | 54. Assist in design of computer programs                            |
| 24. Maintain inventories                                      | 55. Assist in designing lab layout or alterations                    |
| 25. Maintain equipment inventory                              | 56. Establish clinical applications of tests                         |
| 26. Prepare preventative maintenance program                  | 57. Organize laboratory to conform to disaster plan                  |
| 27. Maintain preventive maintenance program                   | 58. Keep orderly log of procedure development                        |
| 28. Establish criteria for introducing new methods            | 59. Recognize possibility of modifying existing methods              |
| 29. Recognize possibility of modifying existing methods       |                                                                      |
| 30. Recognize need to discontinue obsolete methods            |                                                                      |
| 31. Recognize need for new method                             |                                                                      |





GENERAL AREA OF COMPETENCE

## K. PERFORM SPECIALIZED TECHNIQUES

INDIVIDUAL SKILLS

1. Write computer programs
2. Maintain electron microscope
3. Use electron microscope
4. Utilize lab animals
5. Handle lab animals
6. Interpret test results (i.e. clinical significance)



## APPENDIX D

### NEEDS ASSESSMENT SURVEY





Canadian Society of Laboratory Technologists  
Association canadienne des technologistes de laboratoire

The C.S.L.T. Certification Board, with the approval of the Board of Directors, has commissioned the validation of the Syllabus of Studies for initial R.T. (General) certification. This validation will form part of a larger project, a M.Ed. Thesis, entitled "Evaluation of the National Certification Program for Medical Laboratory Technologists in Canada".

As a program head, you have pertinent first-hand information on the existing training programs. Therefore, we request that you complete the attached questionnaire as accurately, honestly and quickly as possible and return it in the enclosed envelope before December 14, 1984. If you have additional comments or information which you feel would be useful in this project, please feel free to include it with the completed questionnaire.

In order to accurately complete this phase of the project, it is essential that we hear from all the training programs in Canada. This is your opportunity as an educator and professional to participate in the future direction of the certification process and the professional organization.

All participants will receive a copy of the summary of the findings so that they can continue to be adequately informed of the educational requirements/regulations across Canada.

We thank you for your assistance and continued support of the C.S.L.T. and its endeavours.

Shirley Beckman  
President  
C.S.L.T.

Sister Dorothy Ryan  
Validation Co-ordinator  
Past President, C.S.L.T.

Dr. K. Puffer, Ph.D.  
Chairman  
Thesis Committee

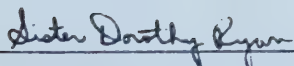
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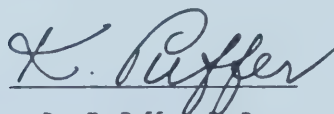
**TRAINING PROGRAM QUESTIONNAIRE**

The attached questionnaire has been designed to solicit pertinent information on admission requirements/regulations and program structure from the training programs in medical laboratory technology across Canada.

In using this information, the author will ensure confidentiality to the respondent and to the institution.



Sister Dorothy Ryan  
Validation Co-ordinator



Dr. K. Puffer, Ph.D.  
Chairman, Thesis Committee

attach.





**A. GENERAL INFORMATION:**

1. Name of institution: \_\_\_\_\_  
\_\_\_\_\_
2. Name of respondent: \_\_\_\_\_  
(for follow up  
purposes)

**B. ADMISSION REQUIREMENTS:**

1. Admission to program from high school:
  - a) grade 11 \_\_\_\_\_
  - b) grade 12 \_\_\_\_\_
  - c) grade 13 \_\_\_\_\_
2. Check (✓) required subjects at above level:
 

|                    |                          |
|--------------------|--------------------------|
| a) Chemistry _____ | d) Mathematics _____     |
| b) Physics _____   | e) English _____         |
| c) Biology _____   | f) Other (specify) _____ |
3. Minimum average required in high school subjects:
  - a) per subject \_\_\_\_\_
  - b) overall \_\_\_\_\_
4. Mean high school average of successful applicants:
  - a) 1984-85: \_\_\_\_\_
  - b) 1983-84: \_\_\_\_\_
  - c) 1982-83: \_\_\_\_\_
5. Length of training program (including clinical training):
  - a) two years \_\_\_\_\_
  - b) three years \_\_\_\_\_
6. Check (✓) if you require for admission:
 

|       |                                        |
|-------|----------------------------------------|
| _____ | personal interview                     |
| _____ | references                             |
| _____ | letter of interest/personal objectives |
| _____ | medical examination                    |
7. Additional admission requirements:
   
\_\_\_\_\_
   
\_\_\_\_\_
   
\_\_\_\_\_
   
\_\_\_\_\_



## C. PROGRAM STRUCTURE:

### Didactic Segment:

1. Length of didactic training: \_\_\_\_\_ (number of months)

If answer is TWO YEARS, what percentage (%) of the first year would be considered DIRECTLY related to medical laboratory technology:

- a) less than 25% \_\_\_\_\_ c) 50% to 75% \_\_\_\_\_  
b) 25% to 50% \_\_\_\_\_ d) over 75% \_\_\_\_\_

2. Do you and your staff feel that this is sufficient time to adequately teach the core content required by the Syllabus of Studies:

- a) Yes \_\_\_\_\_  
b) No \_\_\_\_\_

If NO, what would be your suggestions for change:

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### Clinical Segment:

1. Length of clinical training: \_\_\_\_\_ months

2. Structure: \_\_\_\_\_ "hands on" system  
\_\_\_\_\_ simulated system

3. Do you and your staff feel this is sufficient time to adequately teach practical competencies:

- a) Yes \_\_\_\_\_  
b) No \_\_\_\_\_

If NO, what changes should be made:

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4. What skills are best learned in the clinical laboratory environment?

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**D. SUMMARY: (PROGRAM STRUCTURE):**

1. Is there sufficient time to teach/learn the core content in:

- a) didactic segment \_\_\_\_\_
- b) clinical segment \_\_\_\_\_
- c) total program \_\_\_\_\_

2. Is there sufficient time to teach/learn the practical competencies in:

- a) didactic segment \_\_\_\_\_
- b) clinical segment \_\_\_\_\_
- c) total program \_\_\_\_\_

3. Are you dissatisfied with any particular discipline (in general) in the Syllabus of Studies? If so, which one \_\_\_\_\_.



**E. VALIDATION OF SYLLABUS:**

1. Does the Syllabus of Studies contain the theory, competencies and/or essential skills required by the new graduate?

a) Yes \_\_\_\_\_

b) No \_\_\_\_\_

If NO, what additional skills should be included?

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2. Does the Syllabus of Studies contain theory, competencies and/or skills that are not essential/required by the new graduate?

a) Yes \_\_\_\_\_

b) No \_\_\_\_\_

If YES, specify those areas that are not required by the new graduate and that should be removed from the general Syllabus of Studies.

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3. Does the Syllabus of Studies contain theory, competencies and/or skills that should be reserved to an advanced level of certification?

a) Yes \_\_\_\_\_

b) No \_\_\_\_\_

If YES, specify those areas that should be removed from the general Syllabus of Studies.

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4. Do the C.S.L.T. examinations adequately reflect the:

a) Syllabus of Studies \_\_\_\_\_

b) needs of the new graduate \_\_\_\_\_

5. Other information/comments:

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Canadian Society of Laboratory Technologists  
Association canadienne des technologistes de laboratoire

Le 30 novembre 1984

La Commission de certification de l'A.C.T.L., avec l'approbation du Conseil d'administration, a commissionné la validation du Syllabus d'études pour le diplôme R.T. général initial. Cette validation fera partie d'un plus grand projet, soit une thèse de maîtrise en Éducation, intitulée "Evaluation of the National Certification Program for Medical Laboratory Technologists in Canada".

En tant que coordonnateur de programme, vous possédez d'importantes renseignements de première-main au sujet des programmes de formation disponibles à l'heure actuelle. C'est pourquoi nous vous demandons de bien vouloir remplir le questionnaire ci-joint le plus précisément, honnêtement et rapidement possible et de nous le retourner dans l'enveloppe ci-incluse avant le 21 décembre. Si vous désirez ajouter quelques commentaires ou renseignements que vous jugez utiles dans le cadre de ce projet, n'hésitez pas à nous les faire parvenir avec le questionnaire dûment rempli.

Il est essentiel, pour mener à bien cette phase du projet, que tous les coordonnateurs de programmes de formation au Canada nous envoient leur réponse. En tant qu'éducateur et professionnel, vous ne devez pas laisser passer cette occasion de prendre part à la direction future du processus de certification et de l'organisation professionnelle.

Tous les participants recevront un aperçu des conclusions, les mettant au courant des exigences et règlements mis en pratique dans le domaine de l'enseignement au Canada.

Nous vous remercions de votre collaboration et de votre appui continuuel à l'égard de l'A.C.T.L. et de ses entreprises.

*Shirley Beckman*

Shirley Beckman  
Présidente de  
l'A.C.T.L.

*Sister Dorothy Ryan*

Soeur Dorothy Ryan  
Coordonnatrice de  
la validation  
Présidente sortant  
de charge

*K. Kupper*

Dr. K. Kupper, Ph.D.  
Président du Comité  
de thèse

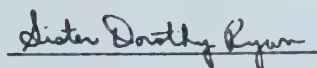
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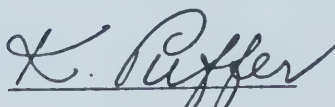
**QUESTIONNAIRE CONCERNANT LE PROGRAMME DE FORMATION**

Le questionnaire ci-joint a été conçu dans le but d'obtenir, de la part des coordonnateurs de programmes de formation en technologie de laboratoire médical à travers le Canada, une quantité de renseignements utiles concernant les conditions et les règlements d'admission ainsi que la structure des programmes.

L'auteur garantit au répondant et à l'institution que tous les renseignements contenus dans ce questionnaire resteront confidentiels.



Soeur Dorothy Ryan  
Coordonnatrice de la validation



Dr. K. Puffer, Ph.D.  
Président, Comité de thèse

Pièce jointe



**A. RENSEIGNEMENTS GÉNÉRAUX:**

1. Nom de l'institution: \_\_\_\_\_  
\_\_\_\_\_
2. Nom du répondant: \_\_\_\_\_  
(pour donner suite  
au questionnaire)

**B. CONDITIONS D'ADMISSION:**

1. Admission au programme à la fin du secondaire:
  - a) 11e année \_\_\_\_\_
  - b) 12e année \_\_\_\_\_
  - c) 13e année \_\_\_\_\_
2. Cochez (✓) les matières obligatoires au niveau cité plus haut:
 

|                   |                            |
|-------------------|----------------------------|
| a) Chimie _____   | d) Mathématiques _____     |
| b) Physique _____ | e) Anglais _____           |
| c) Biologie _____ | f) Autre (spécifiez) _____ |
3. Moyenne minimum exigée pour les matières enseignées au secondaire:
  - a) pour chaque matière \_\_\_\_\_
  - b) moyenne générale \_\_\_\_\_
4. Moyenne générale au secondaire des candidats choisis:
  - a) 1984-85: \_\_\_\_\_
  - b) 1983-84: \_\_\_\_\_
  - c) 1982-83: \_\_\_\_\_
5. Durée du programme de formation (y compris la formation clinique):
  - a) deux ans \_\_\_\_\_
  - b) trois ans \_\_\_\_\_
6. Cochez (✓) si requis au moment de l'admission:
 

|       |                                                   |
|-------|---------------------------------------------------|
| _____ | entrevue personnelle                              |
| _____ | références                                        |
| _____ | lettre décrivant intérêts et objectifs personnels |
| _____ | examen médical                                    |
7. Conditions d'admission supplémentaires:
   
\_\_\_\_\_
   
\_\_\_\_\_
   
\_\_\_\_\_
   
\_\_\_\_\_



## C. STRUCTURE DU PROGRAMME:

## Partie didactique:

1. Durée de la formation didactique: \_\_\_\_\_ (nombre de mois).

Si la durée est de DEUX ANS, quel pourcentage (%) de la première année serait considérée comme DIRECTEMENT reliée à la technologie de laboratoire médical:

- a) moins de 25% \_\_\_\_\_ c) 50% à 75% \_\_\_\_\_  
 b) 25% à 50% \_\_\_\_\_ d) plus de 75% \_\_\_\_\_

2. Selon vous et votre personnel, est-ce assez de temps pour enseigner de manière adéquate la matière de base exigée par le Syllabus d'études:

- a) Oui \_\_\_\_\_  
 b) Non \_\_\_\_\_

Si NON, quels changements suggérez-vous?

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## Partie clinique:

1. Durée de la formation clinique: \_\_\_\_\_ mois.

2. Structure: \_\_\_\_\_ système basé sur l'expérience pratique  
 \_\_\_\_\_ système basé sur la simulation

3. Selon vous et votre personnel, est-ce assez de temps pour enseigner de manière adéquate des compétences d'ordre pratique:

- a) Oui \_\_\_\_\_  
 b) Non \_\_\_\_\_

Si NON, quels changements suggérez-vous?

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4. Quelles compétences sont plus facilement apprises dans le contexte du laboratoire clinique?

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**D. RÉSUMÉ: (STRUCTURE DU PROGRAMME):**

1. Y a-t-il suffisamment de temps pour enseigner/apprendre la matière de base durant la période consacrée à:
  - a) la partie didactique \_\_\_\_\_
  - b) la partie clinique \_\_\_\_\_
  - c) la totalité du programme \_\_\_\_\_
  
2. Y a-t-il suffisamment de temps pour enseigner/apprendre les compétences d'ordre pratique durant la période consacrée à:
  - a) la partie didactique \_\_\_\_\_
  - b) la partie clinique \_\_\_\_\_
  - c) la totalité du programme \_\_\_\_\_
  
3. Êtes-vous satisfait, en général, du choix des disciplines incluses dans le Syllabus d'études. Si non, spécifiez: \_\_\_\_\_

\_\_\_\_\_



**E. VALIDATION DU SYLLABUS:**

1. Le Syllabus d'études contient-il la théorie et les compétences essentielles ou nécessaires au nouveau diplômé?

a) Oui \_\_\_\_\_

b) Non \_\_\_\_\_

Si NON, quelles compétences supplémentaires devrait-on ajouter?

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2. Le Syllabus d'études contient-il de la théorie et des compétences qui ne seraient pas essentielles ou nécessaires au nouveau diplômé?

a) Oui \_\_\_\_\_

b) Non \_\_\_\_\_

Si OUI, spécifiez les domaines qui ne sont pas nécessaires au nouveau diplômé et qui devraient être retirés du Syllabus d'études général.

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3. Le Syllabus d'études contient-il de la théorie et des compétences qui relèvent d'un niveau de certification avancé?

a) Oui \_\_\_\_\_

b) Non \_\_\_\_\_

Si OUI, spécifiez les domaines qui devraient être retirés du Syllabus d'études général.

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4. Les examens de l'A.C.T.L. reflètent-ils de façon adéquate:

a) le Syllabus d'études \_\_\_\_\_

b) les besoins du nouveau diplômé \_\_\_\_\_

5. Autres renseignements ou commentaires:

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Canadian Society of Laboratory Technologists  
Association canadienne des technologistes de laboratoire

January 18, 1985

In December 1984, the C.S.L.T distributed a Training Program Questionnaire to the heads of all medical laboratory training programs in Canada as part of the Syllabus of Studies validation process. The responses from this questionnaire are to provide background information for the study and follow-up questions for inclusion in the subsequent student and employer surveys.

To date, 16 (51.6%) of the questionnaires have been completed and returned. The tabulated responses are quite informative and should provide excellent follow-up material. However, any conclusions may be suspect due to the low percentage of return.

Since I have not received a response from your institution, I am enclosing a second questionnaire for your use. I would ask you to return the completed questionnaire to me no later than February 6th, 1985.

It is important that we hear from you so that our information is truly representative of all regions and all programs in Canada.

Thank you for your assistance in this matter.

Sincerely,

*Sister Dorothy Ryan*

Sister Dorothy Ryan  
Validation Co-ordinator

RETURN ADDRESS: Sister Dorothy Ryan  
Medical Laboratory Science  
B-117 Clinical Sciences Building  
University of Alberta  
T6G 3E8

Encl.

/ld





Canadian Society of Laboratory Technologists  
Association canadienne des technologistes de laboratoire

1e 18 janvier 1985

En décembre 1984, l'A.C.T.L. a distribué un questionnaire concernant les programmes de formation, à tous les directeurs canadiens de programmes de formation en techniques de laboratoire médical; ce questionnaire fait partie du processus de validation des syllabus d'études. Les réponses doivent servir d'élément de base à des fins d'études et comme questions complémentaires à inclure dans les futures enquêtes auprès des étudiants et employeurs.

À date, 16 (51.6%) questionnaires ont été complétés et retournés. Les réponses classifiées sont très utiles au niveau de l'information et pourraient fournir un excellent matériel complémentaire. Cependant toute conclusion semble incertaine en raison du faible pourcentage de réponses.

N'ayant pas reçu de réponse de votre institution, je vous fais parvenir un second questionnaire et vous demanderais de bien vouloir me le retourner dûment complété au plus tard le 10 février 1985.

Votre participation est essentielle afin que cette information soit vraiment représentative de tous les programmes et de toutes les régions à travers le Canada.

Je vous remercie de votre collaboration.

Sincèrement,

*Sister Dorothy Ryan*

Soeur Dorothy Ryan  
Coordinatrice du programme de validation

ADRESSE DE RETOUR: Soeur Dorothy Ryan  
Medical Laboratory Science  
B-117 Clinical Sciences Building  
University of Alberta  
T6G 3E8

Annexe  
/lm





## APPENDIX E

### FOLLOW-UP SURVEY





Canadian Society of Laboratory Technologists  
Association canadienne des technologistes de laboratoire

Dear Graduate,

The C.S.L.T. is conducting a validation survey to determine to what extent the R.T. (General) Syllabus reflects the actual needs of the employer and the technologist in the work place. As a recent graduate from an approved training program, we are requesting your assistance in this project.

Please complete this questionnaire as outlined in the following instruction page, and return it in the enclosed stamped envelope before  
. All respondents will be eligible for one of five  
GRAND PRIZES - free C.S.L.T. membership for 1986 (valued at \$88.00).

This is your opportunity to influence the certification process and to assist in the next revision of the Syllabus of Studies. Your personal participation is essential for the success of this project.

Thank you for your time and honest response.

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Norman Senn  
President  
C.S.L.T.

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Sister Dorothy Ryan  
Validation Co-ordinator

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Dr. K. Puffer, Ph.D.  
Chairman  
Thesis Committee



### INSTRUCTIONS

The main purpose of this graduate survey is to validate the C.S.L.T. Syllabus of Studies in the work place to see if it meets the needs of the new graduate.

You do not need the Syllabus to complete the questionnaire since the level of detail, the categories and the wording of the questions are taken directly from the student requirements of the Syllabus. Please answer the questions regarding the Syllabus and the examinations AS YOU CAN RECALL YOUR TRAINING.

You are not required to complete the entire survey. The following detailed instructions are to assist you with the questionnaire:

#### SECTION 1: GENERAL INFORMATION

to be completed by ALL respondents.

#### SECTION 2: GENERAL KNOWLEDGE

to be completed by ALL respondents.

#### SECTIONS 3-7: INDIVIDUAL DISCIPLINES

complete only those sections that you work in at least 30% of the time. In other words, the most that you should complete is 3 sections in this part.

**EXAMPLE:** If you work exclusively in Clinical Chemistry, complete Section 6 only.

If you are a general duty technologist and work in all areas, complete the 3 Sections that you work in the most.

If you are not working and have not worked during the past year, please return the questionnaire UNANSWERED as you will not be able to respond adequately to the needs of the work place.

THANK YOU

PROCEED TO SECTION 1 



## SECTION 1: GENERAL INFORMATION

## A. PERSONAL DATA

1. Date you obtained R.T.: 1982 ☐ 1983 ☐ 1984 ☐
2. Sex: Male ☐ Female ☐
3. Language of choice: Francophone ☐ Anglophone ☐ Bilingual ☐

4. Length of training program (including clinical training):  
 a) ☐ two years  
 b) ☐ three years  
 c) ☐ four years
5. Present employer: a) ☐ hospital  
 b) ☐ private lab.  
 c) ☐ Red Cross  
 d) ☐ govt. lab  
 e) ☐ other (specify ) \_\_\_\_\_
6. Total number of technologists working in the entire laboratory where you are presently employed ?  
 a) ☐ < 10  
 b) ☐ 10 - 20  
 c) ☐ 21 - 50  
 d) ☐ 51 - 100  
 e) ☐ > 100

7. Present location: \_\_\_\_\_ ( Province )

## B. SUMMARY OF TRAINING

1. Check (✓) those disciplines that you feel were adequately covered in your training program to meet your needs in the work place:
- |                                                   |                                                   |
|---------------------------------------------------|---------------------------------------------------|
| a) <input type="checkbox"/> Clinical Chemistry    | a) <input type="checkbox"/> Clinical Chemistry    |
| b) <input type="checkbox"/> Hematology            | b) <input type="checkbox"/> Hematology            |
| c) <input type="checkbox"/> Histotechnology       | c) <input type="checkbox"/> Histotechnology       |
| d) <input type="checkbox"/> Immunohematology      | d) <input type="checkbox"/> Immunohematology      |
| e) <input type="checkbox"/> Clinical Microbiology | e) <input type="checkbox"/> Clinical Microbiology |
2. Check (✓) those disciplines that you feel should continue to be included in the general R.T. certification program:
- |                                                   |
|---------------------------------------------------|
| a) <input type="checkbox"/> Clinical Chemistry    |
| b) <input type="checkbox"/> Hematology            |
| c) <input type="checkbox"/> Histotechnology       |
| d) <input type="checkbox"/> Immunohematology      |
| e) <input type="checkbox"/> Clinical Microbiology |





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3. Was there sufficient time to learn the practical skills in:
- a) theoretical segment: YES ☐ NO ☐
- b) practical segment : YES ☐ NO ☐
- c) total program : YES ☐ NO ☐
4. Was there sufficient time to learn the essential theoretical knowledge in:
- a) theoretical segment: YES ☐ NO ☐
- b) practical segment : YES ☐ NO ☐
- c) total program : YES ☐ NO ☐
5. Does the Syllabus of Studies contain the theory and/or essential skills required by the NEW graduate ?
- a) ☐ YES
- b) ☐ NO
- If NO, what additional skills should be included ?
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
6. Does the Syllabus of Studies contain theory and/or skills that are not essential/required by the NEW graduate ?
- a) ☐ YES
- b) ☐ NO
- If YES, specify those areas that are not required by the NEW graduate and that should be removed from the Syllabus
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
7. Do the C.S.L.T. examinations cover the material :
- a) in Syllabus of Studies: YES ☐ NO ☐
- b) needed by the NEW graduate: YES ☐ NO ☐
- COMMENTS: \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
8. Estimate the amount of time (in \$) that you have spent working in each area during the past 1-2 years of employment:
- a) \_\_\_\_\_ Clinical Chemistry
- b) \_\_\_\_\_ Hematology
- c) \_\_\_\_\_ Histotechnology
- d) \_\_\_\_\_ Immunohematology
- e) \_\_\_\_\_ Microbiology
9. Estimate the amount of time (in \$) that you have spent working in each area during the past 1-2 years of employment:
- a) \_\_\_\_\_ Clinical Chemistry
- b) \_\_\_\_\_ Hematology
- c) \_\_\_\_\_ Histotechnology
- d) \_\_\_\_\_ Immunohematology
- e) \_\_\_\_\_ Microbiology







B. Additional comments on general knowledge section:

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[illegible][illegible]



[illegible]



☐ NO ☐ YES

If YES, indicate (✓) which of the following is required to work in your laboratory.

If NO, proceed to question F.

[illegible]

**F.** How well did your training prepare you to recognize the causes, the effects and the resolution of the following problems routinely encountered in the Immunohematology department?

| ITEM                              | TOO MUCH PREPARATION     | PREPARATION OKAY         | NOT ENOUGH PREPARATION   | NOT PREPARED AT ALL      |
|-----------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. rouleaux formation             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. panagglutinins                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. polyagglutinins                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. cold autoagglutinine           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Mearon's jelly                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. prozones                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Coombs effect                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. antigen/antibody deterioration | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. mixed field agglutination      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |



ITEM

## REQUIRED IN THE WORK PLACE

NO NICE TO KNOW OFTEN NEEDED ESSENTIAL

**OFTEN  
NEEDED****ESSENTIAL**

1. Antibody detection and/or identification:
  - a) criteria for the selection of screening cells
  - b) criteria for the selection of panel cells
  - c) use of cold autoabsorption
  - d) use of monospecific anti-IgG
  - e) detection of alloantibodies
  - f) specificity of autoantibodies (warm & cold)
  - g) drug induced hemolytic anemia: problems
2. Compatibility testing:
  - a) verifying I.D. of the patient
  - b) verifying patient specimens
  - c) verifying donor units
  - d) significance of the following tests:
    - i) saline room temperature
    - ii) LISS room temperature
    - iii) saline 37°C
    - iv) albumin 37°C
    - v) LISS 37°C
    - vi) saline indirect antiglobulin
    - vii) albumin indirect antiglobulin
    - viii) LISS 37°C indirect antiglobulin
    - ix) one stage enzyme 37°C test
    - x) two stage enzyme 37°C test
    - xi) enzyme antiglobulin
  - e) limitations of compatibility tests







## REQUIRED IN THE WORK PLACE

NC

**OFTEN  
NEEDED**

**ESSENTIAL**

1. Selecting donor blood:
  - a) in routine & emergency situations
  - b) when recipient's specimen is not available
  - c) when group specific blood is not available
  - d) N.B. of visual checking of donor units prior to issuing
2. High incidence antibodies: problems
3. Low incidence antibodies: problems
4. Transfusion reactions:
  - a) allo-immunization: consequences
  - b) criteria used to differentiate urticarial, anaphylactic, febrile & hemolytic reactions
  - c) preventive measures taken
  - d) procedure for investigation
5. Hemolytic disease of the newborn:
  - a) causes and clinical symptoms
  - b) investigative tests: i) prenatal
    - ii) postnatal
  - c) acid elution test for detection of fetal red cells in maternal circulation
  - d) bile pigments in amniotic fluid: significance
  - e) constituents and use of Rh immune globulin
  - f) selection of donor blood:
    - i) for exchange transfusion
    - ii) for intrauterine transfusion

CSLT SYLLABUS 18

**TOO  
DETAILED**

OKAY

**NOT ENOUGH  
DETAIL**



**INSTRUCTION:** THIS SECTION IS TO BE COMPLETED BY THOSE TECHNOLOGISTS WHO WORK IN HEMATOLOGY AT LEAST 30% OF THE TIME. IF YOU DO NOT WORK IN HEMATOLOGY AT LEAST 30% OF THE TIME, MOVE ON TO SECTION 5 

A. For each method below, indicate (✓) what you feel you need to know as a new graduate to work effectively in Hematology.

[illegible]



|                                                  | SHOULD BE REQUIRED FOR EXAM |    | REQUIRED IN THE WORK PLACE |              |              |           |
|--------------------------------------------------|-----------------------------|----|----------------------------|--------------|--------------|-----------|
|                                                  | YES                         | NO | NO                         | NICE TO KNOW | OFTEN NEEDED | ESSENTIAL |
| 1. <u>Peripheral blood:</u> a) erythrocytes      |                             |    |                            |              |              |           |
| b) leukocytes: mature granulocytes               |                             |    |                            |              |              |           |
| lymphocytes                                      |                             |    |                            |              |              |           |
| monocytes                                        |                             |    |                            |              |              |           |
| c) platelets                                     |                             |    |                            |              |              |           |
| 2. <u>Bone marrow precursors:</u> a) blast cells |                             |    |                            |              |              |           |
| b) RBC: pronormoblast                            |                             |    |                            |              |              |           |
| basophilic normoblast                            |                             |    |                            |              |              |           |
| polychromatic normoblast                         |                             |    |                            |              |              |           |
| orthochromatic normoblast                        |                             |    |                            |              |              |           |
| c) WBC: promyelocyte                             |                             |    |                            |              |              |           |
| myelocyte                                        |                             |    |                            |              |              |           |
| metamyelocyte                                    |                             |    |                            |              |              |           |
| band cell                                        |                             |    |                            |              |              |           |
| immature monocyte, and lymphocyte                |                             |    |                            |              |              |           |
| d) megakaryocyte                                 |                             |    |                            |              |              |           |

C. For each staining method below, indicate (✓) the appropriate response.

|                                          | <b>1 SHOULD BE REQUIRED FOR EXAM</b> |                          | <b>2 REQUIRED FOR WORK PLACE</b> |                          |                          |                          | <b>3 IF YES TO 2, REQUIREMENT IN WORK PLACE IS:</b> |                           |  |  |  |  |
|------------------------------------------|--------------------------------------|--------------------------|----------------------------------|--------------------------|--------------------------|--------------------------|-----------------------------------------------------|---------------------------|--|--|--|--|
|                                          | <b>YES</b>                           | <b>NO</b>                | <b>YES</b>                       | <b>NO</b>                | <b>APPLICATION</b>       | <b>PROCEDURE</b>         | <b>PREPARATION OF REAGENTS</b>                      | <b>PRINCIPLE OF STAIN</b> |  |  |  |  |
| 1. Romanowsky stains: Wright's<br>Giemsa | <input type="checkbox"/>             | <input type="checkbox"/> | <input type="checkbox"/>         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                            | <input type="checkbox"/>  |  |  |  |  |
| 2. Perls' Prussian blue reaction         | <input type="checkbox"/>             | <input type="checkbox"/> | <input type="checkbox"/>         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                            | <input type="checkbox"/>  |  |  |  |  |
| 3. Supravital stain (reticulocytes)      | <input type="checkbox"/>             | <input type="checkbox"/> | <input type="checkbox"/>         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                            | <input type="checkbox"/>  |  |  |  |  |



| INSTRUMENTS                    | PRINCIPLE OF OPERATION   | APPLICATION & USE        | CALIBRATION              | ROUTINE MAINTENANCE      |
|--------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. Electronic cell counters    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Hemoglobinometers           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Automatic slide stainers    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Coagulation timers          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Microhematocrit centrifuges | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

[illegible]





[illegible]



ABNORMAL BLOOD CELL  
MORPHOLOGY

| REQUIREMENT IN THE WORK PLACE                               | SIGNIFICANCE |              |
|-------------------------------------------------------------|--------------|--------------|
|                                                             | APPEARANCE   | NOT REQUIRED |
| 1. The work place shall be clean and tidy.                  |              |              |
| 2. The work place shall be free from any obstruction.       |              |              |
| 3. The work place shall be free from any fire hazard.       |              |              |
| 4. The work place shall be free from any health hazard.     |              |              |
| 5. The work place shall be free from any noise hazard.      |              |              |
| 6. The work place shall be free from any vibration hazard.  |              |              |
| 7. The work place shall be free from any radiation hazard.  |              |              |
| 8. The work place shall be free from any chemical hazard.   |              |              |
| 9. The work place shall be free from any biological hazard. |              |              |
| 10. The work place shall be free from any physical hazard.  |              |              |

NSLT SYLLABUS IS

- TOO DETAILED
- OKAY
- NOT ENOUGH DETAIL

1. Hypochromia
2. Polychromasia
3. Anisocytosis
4. Polikilocytosis
5. Microcytosis
6. Macrocytosis
7. Spherocytosis
8. Ovalocytosis
9. Burr cells
10. Schistocytes
11. Target cells
12. Sickle cells
13. Crumated cells
14. Malarial parasites
15. Stomatocytes
16. Acanthocytes
17. Red cell inclusions
18. White cell inclusions
19. Auer rods
20. Hypersegmentation
21. Pelger-huet anomaly
22. Leukopenia/Leukocytosis
23. Thrombocytopenia/Thrombocytosis
24. Atypical Lymphocytes

[illegible]



INSTRUCTION: THIS SECTION IS TO BE COMPLETED BY THOSE TECHNOLOGISTS WHO WORK IN CLINICAL MICROBIOLOGY AT LEAST 30% OF THE TIME. IF YOU DO NOT WORK IN CLINICAL MICROBIOLOGY AT LEAST 30% OF THE TIME, PROCEED TO SECTION 3.

A. For each item below, check (✓) the appropriate responses.

| ITEM                                      | 1 SHOULD BE REQUIRED FOR EXAM |                          | 2 REQUIRED FOR WORK PLACE |                          | 3 IF YES TO 2, REQUIREMENT IN WORK PLACE IS: |                          |                          | 4 CSLT SYLLABUS IS:      |                          |                          |
|-------------------------------------------|-------------------------------|--------------------------|---------------------------|--------------------------|----------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|                                           | YES                           | NO                       | YES                       | NO                       | NICE TO KNOW                                 | OFTEN NEEDED             | ESSENTIAL                | TOO DETAILED             | OKAY                     | NOT ENOUGH DETAIL        |
| 1. Characteristics of bacteria:           |                               |                          |                           |                          |                                              |                          |                          |                          |                          |                          |
| a) nuclear structure                      | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) cytoplasmic structure                  | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) cell wall composition                  | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d) flagella                               | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e) method: nuclear division               | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| f) relationship with plant/animal kingdom | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| g) bacterial growth curve                 | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| h) morphology of bacterial colonies       | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Anatomy of eubacterial cell            |                               |                          |                           |                          |                                              |                          |                          |                          |                          |                          |
| 3. Culture media: prep. & storage         |                               |                          |                           |                          |                                              |                          |                          |                          |                          |                          |
| a) blood agar plates                      | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) tube slanted media                     | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) medium with heat sensitive ingredient  | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d) checking/adjusting of pH               | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e) criteria for pH 7 Eh indicators        | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| f) storage of dehydrated/prepared media   | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Function & ingredients of:             |                               |                          |                           |                          |                                              |                          |                          |                          |                          |                          |
| a) blood agar                             | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) fluid media for primary culture        | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) differential media                     | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d) selective media                        | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e) transport media                        | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |



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B. For the following differential procedures, indicate (✓) what is needed to work effectively in clinical microbiology.

| DIFFERENTIAL PROCEDURES                     | PRINCIPLE                | APPLICATION              | INTERPRETATION           | PERFORMANCE OF TEST      | USE OF CONTROLS          |
|---------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. Catalase test                            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Slide/tube coagulase test                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Hemolysis on blood agar plates           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Bacitracin susceptibility                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Optochin sensitivity                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Bile solubility                          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Esculin hydrolysis                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Growth on 40% bile agar                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Growth in 6.5% NaCl broth                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Oxidase test                            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. Carbohydrate fermentation               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. Triple sugar iron (TSI) agar            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. Methylene red (MR) test                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. Voges-Proskauer test                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. ONPG test                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 16. Indole production                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 17. Urease test                             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 18. Simmons' citrate test                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 19. Decarboxylase tests                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 20. Phenylalanine deaminase test            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 21. Nitrate/nitrite reduction               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 22. Gelatinase test                         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 23. Pigment production                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 24. H <sub>2</sub> S production in TSI agar | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 25. Motility                                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 26. X & V factor growth requirements        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |





## ORGANISMS

CELLULAR

## STAINING REACTIONS

## GROWTH REQUIREMENTS

TURAL  
BUTAT

**SOURCE OF INFECTION**

PATHOGENICITY

COLONIA

ISOLATION

IDENTIFICATION  
PROCEDURES

1. *Staphylococcus aureus*
2. *Staphylococcus epidermidis*
3. *Micrococcus* species
4. *Streptococcus pyogenes*
5. *Viridans* group
6. *Enterococcus* group
7. *Streptococcus pneumoniae*
8. *Streptococci* (groups B, C, & G)
9. *Peptococcus* species
10. *Peptostreptococcus* species
11. *Lactobacillus* species
12. *Corynebacterium diphtheriae*
13. *Diphtheroids*
14. *Actinomyces israelii*
15. *Naocardia asteroides*
16. *Mycobacterium tuberculosis*
17. *Listeria monocytogenes*
18. *Bacillus anthracis*
19. *Bacillus* species
20. *Clostridium perfringens*
21. *Clostridium tetani*
22. *Clostridium botulinum*
23. *Neisseria gonorrhoeae*
24. *Neisseria meningitidis*
25. *Neisseria lactamica*
26. *Branhamella catarrhalis*
27. *Acinetobacter* species



## ORGANISMS

| CELLULAR MORPHOLOGY | STAINING REACTIONS |
|---------------------|--------------------|
|---------------------|--------------------|

| GROWTH REQUIREMENTS |     | NATURAL HABITAT |     |
|---------------------|-----|-----------------|-----|
| 1                   | 1   | 1               | 1   |
| 2                   | 2   | 2               | 2   |
| 3                   | 3   | 3               | 3   |
| 4                   | 4   | 4               | 4   |
| 5                   | 5   | 5               | 5   |
| 6                   | 6   | 6               | 6   |
| 7                   | 7   | 7               | 7   |
| 8                   | 8   | 8               | 8   |
| 9                   | 9   | 9               | 9   |
| 10                  | 10  | 10              | 10  |
| 11                  | 11  | 11              | 11  |
| 12                  | 12  | 12              | 12  |
| 13                  | 13  | 13              | 13  |
| 14                  | 14  | 14              | 14  |
| 15                  | 15  | 15              | 15  |
| 16                  | 16  | 16              | 16  |
| 17                  | 17  | 17              | 17  |
| 18                  | 18  | 18              | 18  |
| 19                  | 19  | 19              | 19  |
| 20                  | 20  | 20              | 20  |
| 21                  | 21  | 21              | 21  |
| 22                  | 22  | 22              | 22  |
| 23                  | 23  | 23              | 23  |
| 24                  | 24  | 24              | 24  |
| 25                  | 25  | 25              | 25  |
| 26                  | 26  | 26              | 26  |
| 27                  | 27  | 27              | 27  |
| 28                  | 28  | 28              | 28  |
| 29                  | 29  | 29              | 29  |
| 30                  | 30  | 30              | 30  |
| 31                  | 31  | 31              | 31  |
| 32                  | 32  | 32              | 32  |
| 33                  | 33  | 33              | 33  |
| 34                  | 34  | 34              | 34  |
| 35                  | 35  | 35              | 35  |
| 36                  | 36  | 36              | 36  |
| 37                  | 37  | 37              | 37  |
| 38                  | 38  | 38              | 38  |
| 39                  | 39  | 39              | 39  |
| 40                  | 40  | 40              | 40  |
| 41                  | 41  | 41              | 41  |
| 42                  | 42  | 42              | 42  |
| 43                  | 43  | 43              | 43  |
| 44                  | 44  | 44              | 44  |
| 45                  | 45  | 45              | 45  |
| 46                  | 46  | 46              | 46  |
| 47                  | 47  | 47              | 47  |
| 48                  | 48  | 48              | 48  |
| 49                  | 49  | 49              | 49  |
| 50                  | 50  | 50              | 50  |
| 51                  | 51  | 51              | 51  |
| 52                  | 52  | 52              | 52  |
| 53                  | 53  | 53              | 53  |
| 54                  | 54  | 54              | 54  |
| 55                  | 55  | 55              | 55  |
| 56                  | 56  | 56              | 56  |
| 57                  | 57  | 57              | 57  |
| 58                  | 58  | 58              | 58  |
| 59                  | 59  | 59              | 59  |
| 60                  | 60  | 60              | 60  |
| 61                  | 61  | 61              | 61  |
| 62                  | 62  | 62              | 62  |
| 63                  | 63  | 63              | 63  |
| 64                  | 64  | 64              | 64  |
| 65                  | 65  | 65              | 65  |
| 66                  | 66  | 66              | 66  |
| 67                  | 67  | 67              | 67  |
| 68                  | 68  | 68              | 68  |
| 69                  | 69  | 69              | 69  |
| 70                  | 70  | 70              | 70  |
| 71                  | 71  | 71              | 71  |
| 72                  | 72  | 72              | 72  |
| 73                  | 73  | 73              | 73  |
| 74                  | 74  | 74              | 74  |
| 75                  | 75  | 75              | 75  |
| 76                  | 76  | 76              | 76  |
| 77                  | 77  | 77              | 77  |
| 78                  | 78  | 78              | 78  |
| 79                  | 79  | 79              | 79  |
| 80                  | 80  | 80              | 80  |
| 81                  | 81  | 81              | 81  |
| 82                  | 82  | 82              | 82  |
| 83                  | 83  | 83              | 83  |
| 84                  | 84  | 84              | 84  |
| 85                  | 85  | 85              | 85  |
| 86                  | 86  | 86              | 86  |
| 87                  | 87  | 87              | 87  |
| 88                  | 88  | 88              | 88  |
| 89                  | 89  | 89              | 89  |
| 90                  | 90  | 90              | 90  |
| 91                  | 91  | 91              | 91  |
| 92                  | 92  | 92              | 92  |
| 93                  | 93  | 93              | 93  |
| 94                  | 94  | 94              | 94  |
| 95                  | 95  | 95              | 95  |
| 96                  | 96  | 96              | 96  |
| 97                  | 97  | 97              | 97  |
| 98                  | 98  | 98              | 98  |
| 99                  | 99  | 99              | 99  |
| 100                 | 100 | 100             | 100 |

## SOURCE OF INFECTION

**PATHOGENICITY**

COLONIAL  
MORPHOLOGICALISOLATION  
PROCEDURESIDENTIFICATION  
PROCEDURES

1. *Escherichia coli*
2. *Edwardiella tarda*
3. *Citrobacter species*
4. *Salmonella typhi*
5. *Salmonella arizonae*
6. *Salmonella species*
7. *Shigella species*
8. *Klebsiella species*
9. *Enterobacter cloacae*
10. *Enterobacter aerogenes*
11. *Haemolyticus alvei*
12. *Serratia marcescens*
13. *Proteus mirabilis*
14. *Yersinia enterocolitica*
15. *Vibrio*
16. *Aeromonas*
17. *Haemophilus influenzae*
18. *Gardnerella (Haemophilus) vaginalis*
19. *Pasteurella multocida*
20. *Pseudomonas aeruginosa*
21. *Alcaligenes species*
22. *Brucella abortus*
23. *Bordetella pertussis*
24. *Bacteroides species*
25. *Treponema pallidum*



- 5 -

E. For each clinical specimen below, check (✓) those items required for proper examination of specimen in the work place.

| CLINICAL SPECIMENS          | SAFETY PRECAUTIONS       | SUITABILITY OF SPECIMEN  | MACROSCOPIC EXAMINATION  | MICROSCOPIC EXAMINATION  | APPROPRIATE MEDIA        | INOCULATION OF PRIMARY ISOLATION MEDIA | TESTS FOR IDENTIFICATION | NEED FOR PRELIMINARY REPORT |
|-----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|----------------------------------------|--------------------------|-----------------------------|
| 1. Blood culture            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 2. CSF                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 3. Effusions                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 4. Biopsied tissue          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 5. Surgical wounds          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 6. Urine                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 7. Feces                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 8. Sputum                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 9. Swab from ear            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 10. Swab from nose          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 11. Swab from throat        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 12. Swab from nasopharynx   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 13. Swab from skin          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 14. Swab from genital tract | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |

F. Does your laboratory routinely do mycology? Yes ☐ No ☐

If YES, indicate (✓) which of the following is required to work effectively in your laboratory.

If NO, proceed to question G →

| YEAST-LIKE FUNGI                     | GROWTH REQUIREMENTS      | NATURAL HABITAT          | SOURCES OF INFECTION     | PATHOGENICITY            | DIFFERENTIATION OF ORGANISM |
|--------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-----------------------------|
| 1. <i>Candida albicans</i>           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>    |
| 2. Other <i>Candida</i> species      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>    |
| 3. <i>Cryptococcus neoformans</i>    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>    |
| 4. Other <i>Cryptococcus</i> species | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>    |
| 5. <i>Torulopsis glabrata</i>        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>    |



G. For each item below, check (✓) the appropriate responses.

| ITEM                                              | 1 SHOULD BE REQUIRED FOR IDIAN |                          | 2 REQUIRED FOR WORK PLACE |                          | 3 IF YES TO 2, REQUIREMENT IN WORK PLACE IS: |                          |                          | 4 CULT SYLLABUS IS:      |                          |                          |
|---------------------------------------------------|--------------------------------|--------------------------|---------------------------|--------------------------|----------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|                                                   | YES                            | NO                       | YES                       | NO                       | NICE TO KNOW                                 | OFTEN NEEDED             | ESSENTIAL                | TOO DETAILED             | OKAY                     | NOT ENOUGH DETAIL        |
| 1. <u>Quality control:</u> sterility testing      | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. <u>Culturing:</u>                              |                                |                          |                           |                          |                                              |                          |                          |                          |                          |                          |
| a) Streaking petri plate media                    | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) Transferring bacteria by wire loop/needle      | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) Accurate pipetting of bacterial suspensions    | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d) Inoculation of broth cultures                  | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e) Selective cultivation of micro-organisms       | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| f) Viable counts using loop technique             | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| g) Use of dipalides                               | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| h) Anaerobic culturing using anaerobic jar        | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| i) Use of Eh Indicators                           | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| j) Culturing in CO <sub>2</sub> atmosphere        | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| k) Preservation of stock cultures                 | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Blood cultures: a) collection of specimens     | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) subculturing                                   | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) incubation periods                             | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. <u>Cerebrospinal fluid:</u>                    |                                |                          |                           |                          |                                              |                          |                          |                          |                          |                          |
| a) significance of presence of WBC cells          | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. <u>Respiratory Tract:</u>                      |                                |                          |                           |                          |                                              |                          |                          |                          |                          |                          |
| a) technique for liquefaction of sputum           | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) microscopic appearances of Vincent's infection | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. <u>Microscopic examination</u>                 |                                |                          |                           |                          |                                              |                          |                          |                          |                          |                          |
| a) wet preparations for motility                  | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) use of Gram stain                              | <input type="checkbox"/>       | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |







| ITEM                                                                   | 1<br>SHOULD BE REQUIRED FOR EXAM | 2<br>REQUIRED FOR WORK PLACE | 3<br>IF YES TO [2], REQUIREMENT IN WORK PLACE IS: | 4<br>CSLT SYLLABUS IS:              |
|------------------------------------------------------------------------|----------------------------------|------------------------------|---------------------------------------------------|-------------------------------------|
|                                                                        | YES NO                           | YES NO                       | NICE TO KNOW OFTEN NEEDED ESSENTIAL               | TOO DETAILED OKAY NOT ENOUGH DETAIL |
| <u>Antimicrobial susceptibility testing</u>                            |                                  |                              |                                                   |                                     |
| 1. Bacteriostatic activity                                             | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>                          | <input type="checkbox"/>            |
| 2. Bactericidal activity                                               | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>                          | <input type="checkbox"/>            |
| 3. Antimicrobial spectrum of antibiotics                               | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>                          | <input type="checkbox"/>            |
| 4. Use of Kirby-Bauer technique:                                       | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>                          | <input type="checkbox"/>            |
| a) prep. of MacFarland BaSO <sub>4</sub> standard                      | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>                          | <input type="checkbox"/>            |
| b) prep./standardization of inoculum                                   | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>                          | <input type="checkbox"/>            |
| c) use of Mueller-Hinton agar                                          | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>                          | <input type="checkbox"/>            |
| d) preparation/inoculation of agar plates                              | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>                          | <input type="checkbox"/>            |
| e) reading/interpretation of results                                   | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>                          | <input type="checkbox"/>            |
| f) storage of discs                                                    | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>                          | <input type="checkbox"/>            |
| g) Limitations of the technique                                        | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>                          | <input type="checkbox"/>            |
| 5. Detection of B-lactamase production                                 | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>                          | <input type="checkbox"/>            |
| 6. Principle of the Schlichter test ( <i>sensu</i> bactericidal level) | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>                          | <input type="checkbox"/>            |
| <u>Parasitology</u>                                                    |                                  |                              |                                                   |                                     |
| a) use of Scotch (R) tape preparations                                 | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>                          | <input type="checkbox"/>            |
| b) morphology of pinworm eggs                                          | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>                          | <input type="checkbox"/>            |
| c) wet mounts for Trichomonas vaginalis                                | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>                          | <input type="checkbox"/>            |
| <u>Active immunization:</u>                                            |                                  |                              |                                                   |                                     |
| a) use of live attenuated vaccines                                     | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>                          | <input type="checkbox"/>            |
| b) use of killed vaccines                                              | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>                          | <input type="checkbox"/>            |
| c) use of toxoids                                                      | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>                          | <input type="checkbox"/>            |
| <u>Passive Immunization</u>                                            |                                  |                              |                                                   |                                     |
| a) use of antitoxins                                                   | <input type="checkbox"/>         | <input type="checkbox"/>     | <input type="checkbox"/>                          | <input type="checkbox"/>            |



| SEROLOGICAL METHODS                                                    | PRINCIPLE                | APPLICATION              | INTERPRETATION           | PERFORMANCE OF TEST      | USE OF CONTROLS          |
|------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. Slide agglutination tests<br>(for enteropathogenic <i>E. coli</i> ) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Lancefield grouping                                                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Nagler reaction                                                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Elek test                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

[illegible]



.....

A. For each item below, indicate (✓) the appropriate responses.

| ITEM                                                        | 1<br>REQUIRED FOR<br>EXAM       | 2<br>REQUIRED FOR<br>WORK PLACE | 3<br>YES TO [2], REQUIREMENT<br>IN WORK PLACE IS: | 4<br>CSLT SYLLABUS IS:                           |
|-------------------------------------------------------------|---------------------------------|---------------------------------|---------------------------------------------------|--------------------------------------------------|
|                                                             | YES<br><input type="checkbox"/> | YES<br><input type="checkbox"/> | NO<br><input type="checkbox"/>                    | TOO<br>DETAILED<br><input type="checkbox"/>      |
|                                                             | NO<br><input type="checkbox"/>  | NO<br><input type="checkbox"/>  | OFTEN<br>NEEDED<br><input type="checkbox"/>       | NOT ENOUGH<br>DETAIL<br><input type="checkbox"/> |
| 1. Carbohydrates:                                           |                                 |                                 |                                                   |                                                  |
| a) differentiate between mono-, di- and poly- saccharides   | <input type="checkbox"/>        | <input type="checkbox"/>        | <input type="checkbox"/>                          | <input type="checkbox"/>                         |
| b) reducing vs non-reducing sugar                           | <input type="checkbox"/>        | <input type="checkbox"/>        | <input type="checkbox"/>                          | <input type="checkbox"/>                         |
| c) carbohydrate metabolism                                  | <input type="checkbox"/>        | <input type="checkbox"/>        | <input type="checkbox"/>                          | <input type="checkbox"/>                         |
| d) oral glucose tolerance test                              | <input type="checkbox"/>        | <input type="checkbox"/>        | <input type="checkbox"/>                          | <input type="checkbox"/>                         |
| e) 2 hour p.c. blood sugar                                  | <input type="checkbox"/>        | <input type="checkbox"/>        | <input type="checkbox"/>                          | <input type="checkbox"/>                         |
| 2. Lipids: a) solubility characteristics                    | <input type="checkbox"/>        | <input type="checkbox"/>        | <input type="checkbox"/>                          | <input type="checkbox"/>                         |
| b) simple vs compound lipid                                 | <input type="checkbox"/>        | <input type="checkbox"/>        | <input type="checkbox"/>                          | <input type="checkbox"/>                         |
| c) structure of cholesterol                                 | <input type="checkbox"/>        | <input type="checkbox"/>        | <input type="checkbox"/>                          | <input type="checkbox"/>                         |
| d) structure of triglycerides                               | <input type="checkbox"/>        | <input type="checkbox"/>        | <input type="checkbox"/>                          | <input type="checkbox"/>                         |
| e) fatty acid oxidation                                     | <input type="checkbox"/>        | <input type="checkbox"/>        | <input type="checkbox"/>                          | <input type="checkbox"/>                         |
| 3. Proteins: describe ...                                   |                                 |                                 |                                                   |                                                  |
| a) primary structure                                        | <input type="checkbox"/>        | <input type="checkbox"/>        | <input type="checkbox"/>                          | <input type="checkbox"/>                         |
| b) secondary structure                                      | <input type="checkbox"/>        | <input type="checkbox"/>        | <input type="checkbox"/>                          | <input type="checkbox"/>                         |
| c) tertiary structure                                       | <input type="checkbox"/>        | <input type="checkbox"/>        | <input type="checkbox"/>                          | <input type="checkbox"/>                         |
| d) amphoterie properties of proteins                        | <input type="checkbox"/>        | <input type="checkbox"/>        | <input type="checkbox"/>                          | <input type="checkbox"/>                         |
| e) five major protein groups (separated by electrophoresis) | <input type="checkbox"/>        | <input type="checkbox"/>        | <input type="checkbox"/>                          | <input type="checkbox"/>                         |
| 4. Non-protein Nitrogenous Substances:                      |                                 |                                 |                                                   |                                                  |
| a) formation/excretion of a) urea                           | <input type="checkbox"/>        | <input type="checkbox"/>        | <input type="checkbox"/>                          | <input type="checkbox"/>                         |
| b) creatinine                                               | <input type="checkbox"/>        | <input type="checkbox"/>        | <input type="checkbox"/>                          | <input type="checkbox"/>                         |
| c) uric acid                                                | <input type="checkbox"/>        | <input type="checkbox"/>        | <input type="checkbox"/>                          | <input type="checkbox"/>                         |



B. For each item below, indicate (✓) the appropriate responses.

| ITEM                                       | 1 REQUIRED FOR EXAM      |                          | 2 REQUIRED FOR WORK PLACE |                          | 3 IF YES TO 2, REQUIREMENT IN WORK PLACE IS: |                          |                          | 4 CSLT SYLLABUS IS:      |                          |                          |  |
|--------------------------------------------|--------------------------|--------------------------|---------------------------|--------------------------|----------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--|
|                                            | YES                      | NO                       | YES                       | NO                       | NICE TO KNOW                                 | OFTEN NEEDED             | ESSENTIAL                | TOO DETAILED             | OKAY                     | NOT ENOUGH DETAIL        |  |
| 1. <u>Acid-base &amp; Electrolytes:</u>    |                          |                          |                           |                          |                                              |                          |                          |                          |                          |                          |  |
| a) control of blood pH by buffer systems   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| b) regulation of pH by renal system        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| c) regulation of pH by respiratory system  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| d) use of Henderson-Hasselbalch equation   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| e) hemoglobin as an oxygen carrier         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| f) anions and cations in blood             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| g) metabolism of electrolytes              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| h) osmolality                              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| 2. <u>Enzymes:</u>                         |                          |                          |                           |                          |                                              |                          |                          |                          |                          |                          |  |
| a) general structure                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| b) catalytic properties                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| c) classification                          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| d) enzyme activity: what effects?          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| e) measurements: endpoint vs kinetic types | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| f) define isoenzyme                        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| 3. <u>Ligand Assay:</u>                    |                          |                          |                           |                          |                                              |                          |                          |                          |                          |                          |  |
| a) principle                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| b) basic concepts of:                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| - CFB                                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| - FIA                                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| - ETA                                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| 4. <u>Liver Function:</u>                  |                          |                          |                           |                          |                                              |                          |                          |                          |                          |                          |  |
| a) role of liver in:                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| - carbohydrate metabolism                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| - protein metabolism                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| - lipid metabolism                         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| - detoxification                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| - bilirubin metabolism                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |





[illegible]



[illegible]



**INSTRUMENTS**

|      | NOT REQUIRED | PRINCIPLE | APPLICATION |
|------|--------------|-----------|-------------|
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| 2.   |              |           |             |
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1. Continuous flow analyzer
2. Centrifugal analyzer
3. Discrete analyzer
4. Fluorometer
5. Atomic absorption spectrophotometer
6. Flame photometer
7. Densitometer
8. Osmometer
9. Chloridometer
10. Nephelometer
11. Refractometer

ITEM

YES NO

NO

NICE TO KNOW

OFTEN NEEDED

ESSENTIAL

1. Monochromators: principle, application and limitations
2. Light sources: uses
3. Quvettes: types
4. Photodetectors: principle/uses of:
  - a) barrier layer cell
  - b) photoemissive tube
  - c) photomultiplier tube
5. Function of: a) galvanometer  
b) potentiometer
6. Glacking wavelength calibration



G. For each specimen below, indicate (✓) the tests and methods that a new graduate needs to know in the work place.

[illegible]









- 2 -

B. For each fixative agent and compound fixative, indicate (✓) what a new graduate needs to know to function effectively in Histotechnology.

| ITEM                    | THEORY                   | USES                     | ADVANTAGES               | DISADVANTAGES            |
|-------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. Formaldehyde         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Mercuric chloride    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Potassium dichromate | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Picric Acid          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Osmium tetroxide     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Ethanol              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. N.B.F.S.             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Zenker's             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Helly's              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Bouin's             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

C. In decalcification, indicate (✓) what a new graduate needs to know to function effectively in Histotechnology.

| ITEM                                                                            | PRINCIPLE                                                                        | USE                                                                              | ADVANTAGES                                                                       | DISADVANTAGES                                                                    |
|---------------------------------------------------------------------------------|----------------------------------------------------------------------------------|----------------------------------------------------------------------------------|----------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| 1. Formic Acid                                                                  | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                         |
| 2. Nitric Acid                                                                  | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                         |
| 3. EDTA                                                                         | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                         |
| 4. Tests for endpoint:<br>a) chemical<br>b) radiological<br>c) physical probing | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/> | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/> | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/> | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/> |





| ITEM                                                       | 1 REQUIRED FOR EXAM      |                          | 2 REQUIRED FOR WORK PLACE |                          | 3 IF YES TO 2, REQUIREMENT IN WORK PLACE IS: |                          |                          | 4 ONLY SYLLABUS IS:      |                          |                          |
|------------------------------------------------------------|--------------------------|--------------------------|---------------------------|--------------------------|----------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|                                                            | YES                      | NO                       | YES                       | NO                       | NICE TO KNOW                                 | OFTEN NEEDED             | ESSENTIAL                | TOO DETAILED             | OKAY                     | NOT ENOUGH DETAIL        |
| 1. <u>Microtome knives:</u>                                |                          |                          |                           |                          |                                              |                          |                          |                          |                          |                          |
| a) how many degrees is: i) wedge angle                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| ii) clearance angle                                        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) definition of cutting facet                             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. <u>Automatic knife sharpeners:</u>                      |                          |                          |                           |                          |                                              |                          |                          |                          |                          |                          |
| a) routine maintenance                                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) relevance of abrasive particle size to:                 |                          |                          |                           |                          |                                              |                          |                          |                          |                          |                          |
| i) honing (coarse)                                         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| ii) stropping (fine)                                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. <u>Rotary microtome:</u> a) operation                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) importance of clearance angle                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) routine maintenance                                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. <u>Dye chemistry:</u> understanding . . .               |                          |                          |                           |                          |                                              |                          |                          |                          |                          |                          |
| a) resonance systems                                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) dye structure terminology:                              |                          |                          |                           |                          |                                              |                          |                          |                          |                          |                          |
| i) chromophore                                             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| ii) chromogen                                              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| iii) auxochrome                                            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) acid, base & neutral dyes and their staining properties | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d) physical theory of staining                             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e) chemical theory of staining:                            |                          |                          |                           |                          |                                              |                          |                          |                          |                          |                          |
| i) salt linkage                                            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| ii) hydrogen bond                                          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| iii) metachromasia                                         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| iv) metallic impregnation                                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| v) leuco staining                                          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |









[illegible]



- 6 -

G. For each specific staining method below, indicate (✓) what a new graduate needs to know to work effectively in Histotechnology.

| ITEM                                   | THEORY                   | PREPARATION OF REAGENTS  | PRACTISE                 | EVALUATION OF RESULTS    | CORRECTIVE ACTION        | CHOOSING CONTROL TISSUE  | SAFETY PRECAUTIONS       |
|----------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. Hematoxylin & Eosin                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Masson trichrome                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Weigert van Gieson                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Silver impregnation for reticulin   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. P.A.S. (Periodic Acid Schiff)       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. P.A.S. with diastase control        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Perls' Prussian Blue                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Argentaffin method for melanin      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Modified Gram stain                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Ziehl-Neelsen                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. Gomori's methenamine silver        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. Oil Red O                          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. Luxol fast blue/cresyl echt violet | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

H. In paraffin processing, indicate (✓) what the new graduate needs to know regarding each dehydration agent and clearing agent.

| ITEM                                      | USES                     | ADVANTAGES               | DISADVANTAGES            | CORRECTIVE PROCEDURE     |
|-------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. <u>DEHYDRATION AGENTS</u> : a) ethanol | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) isopropanol                            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) acetone                                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. <u>CLEARING AGENTS</u> : a) xylene     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) toluene                                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) chloroform                             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |



APPENDIX F

EMPLOYER SURVEY





Canadian Society of Laboratory Technologists  
Association canadienne des technologistes de laboratoire

Dear prospective employer,

The C.S.L.T. is conducting a validation survey to determine to what extent the R.T. (General) Syllabus reflects the actual needs of the employer and the new graduate in the work place. As a prospective employer of newly certified technologists, we are requesting your assistance in this project.

Please complete the questionnaire as outlined in the following instruction page and return it in the enclosed stamped envelope before . Since we are polling a limited number of prospective employers, it is essential that each surveyed individual complete and return the questionnaire. Your personal participation is very important to the success of this project.

This is your opportunity to influence the certification process and to assist in the next revision of the Syllabus. In this way, the C.S.L.T. will feel confident that it is preparing its new graduates to meet the challenges of the clinical laboratory.

Thank you for your time and honest response.

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Norman Senn  
President  
C.S.L.T.

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Sister Dorothy Ryan  
Validation Co-ordinator

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Dr. K. Puffer, Ph. D.  
Chairman  
Thesis Committee





## INSTRUCTIONS

The main purpose of this employer survey is to validate the C.S.I.T. Syllabus of Studies in the work place to see if it meets the needs of the new graduate.

You do not need the Syllabus to complete the questionnaire since the level of detail, the categories and the wording of the questions are taken directly from the student requirements of the Syllabus.

You may not be required to complete the entire survey. The following detailed instructions are to assist you in answering the questionnaire.

**SECTION 1-GENERAL INFORMATION** to be completed by ALL employers.

**SECTION 2: GENERAL KNOWLEDGE** to be completed by ALL employers.

**SECTIONS 3-7: INDIVIDUAL DISCIPLINES** complete only those sections that are applicable to your laboratory. If you do not have a particular department within your laboratory, omit that part of the questionnaire.

**EXAMPLE:** If you send your histotechnology specimens to a referral laboratory, you should omit that part of the questionnaire because you will not be able to respond adequately to the needs of the work place.

THANK YOU

PROCEED TO SECTION 1 



## SECTION 1: GENERAL INFORMATION

## A. EMPLOYMENT DATA

1. Type of laboratory: a) ☐ hospital  
 b) ☐ private laboratory  
 c) ☐ Red Cross  
 d) ☐ government laboratory  
 e) ☐ other (specify) \_\_\_\_\_
2. Total number of technologists working in the entire laboratory where you are presently employed.
- a) ☐ < 10  
 b) ☐ 10-20  
 c) ☐ 21-50  
 d) ☐ 51-100  
 e) ☐ > 100
3. Location of laboratory: \_\_\_\_\_ (city)  
 \_\_\_\_\_ (province)

## B. R.T. CERTIFICATION PROGRAM

1. As an employer of new graduates, indicate (✓) those disciplines that you feel are adequately covered in the R.T. certification program to meet the needs in the work place:
- a) ☐ Clinical Chemistry  
 b) ☐ Hematology  
 c) ☐ Histotechnology  
 d) ☐ Immunohematology  
 e) ☐ Clinical Microbiology
2. Check (✓) those disciplines that you feel should continue to be included in the general R.T. certification program.
- a) ☐ Clinical Chemistry  
 b) ☐ Hematology  
 c) ☐ Histotechnology  
 d) ☐ Immunohematology  
 e) ☐ Clinical Microbiology

PROCEED TO SECTION 2



# SECTION 2: GENERAL KNOWLEDGE

INSTRUCTION: THIS SECTION SHOULD BE COMPLETED BY ALL EMPLOYERS.

A. For each item below, check (✓) the appropriate responses.

| ITEM                                 | 1 REQUIRED FOR WORK PLACE |                       | 2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS: |                          |                          |
|--------------------------------------|---------------------------|-----------------------|----------------------------------------------|--------------------------|--------------------------|
|                                      | YES                       | NO                    | NICE TO KNOW                                 | OFTEN NEEDED             | ESSENTIAL                |
| 1. Human anatomy and physiology      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. General genetics                  | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Molecular biology                 | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Basic concepts of immunity        | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Introductory inorganic chemistry  | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Introductory organic chemistry    | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Basic physics                     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Lab. mathematics & statistics     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Laboratory safety                 | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Laboratory glass & plastic ware  | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. Sterilization & disinfection     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. Collection of specimens          | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. Laboratory records               | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. Legal aspects & the technologist | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. Basic laboratory instrumentation | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 16. Preventive maintenance           | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 17. Communications                   | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |



B. Additional comments on general knowledge section:

Blank lined paper for notes.





## SECTION 3: IMMUNOHEMATOLOGY

INSTRUCTION: THIS SECTION SHOULD BE COMPLETED BY THOSE EMPLOYERS WHO HAVE AN IMMUNOHEMATOLOGY DEPARTMENT IN THEIR LABORATORY.  
IF YOU DO NOT HAVE AN IMMUNOHEMATOLOGY DEPARTMENT IN YOUR LABORATORY, PROCEED TO SECTION 4. →

A. For each item below, check (✓) the appropriate responses.

| ITEM                                               | 1 REQUIRED FOR WORK PLACE |                       | 2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS: |                          |                          |                          |
|----------------------------------------------------|---------------------------|-----------------------|----------------------------------------------|--------------------------|--------------------------|--------------------------|
|                                                    | YES                       | NO                    | NICE TO KNOW                                 | OFTEN NEEDED             | ESSENTIAL                |                          |
| 1. Factors affecting antigen-antibody reactions    | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Inhibition/neutralization tests                 | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. REAGENTS: origin, storage and ...               | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| a) cell suspension: preparation                    | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) Rh-t <sub>r</sub> control: use                  | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) Antisera: govt. regulations                     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d) Bovine albumin                                  | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e) Saline sol'n: prep., constituents               | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| f) Proteolytic enzymes                             | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Specificity of lectins                          | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. EQUIPMENT: use & application:                   | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| a) refrigerated centrifuge                         | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) blood bank refrigerator                         | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) Rh viewing box                                  | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. BLOOD DONATION:                                 | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| a) criteria for selection of donors                | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) procedure for collection                        | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) tests done on donated blood                     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d) blood components: storage and effect of storage | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e) blood components: clinical use                  | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |



B. For each blood group system below, indicate (+) those items that you feel are necessary to work effectively in Immunohematology

| ITEM             | Characteristics of antigens | Characteristics of antibodies | Clinical sign. of antibodies | Nomenclature             | Frequency of Phenotypes  | Phenotyping Procedures   | Interpretation of Phenotyping Results | Use of appropriate Controls | Causes of Anomalous Results |
|------------------|-----------------------------|-------------------------------|------------------------------|--------------------------|--------------------------|--------------------------|---------------------------------------|-----------------------------|-----------------------------|
| 1. ABO System    | <input type="checkbox"/>    | <input type="checkbox"/>      | <input type="checkbox"/>     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>              | <input type="checkbox"/>    | <input type="checkbox"/>    |
| 2. LEWIS System  | <input type="checkbox"/>    | <input type="checkbox"/>      | <input type="checkbox"/>     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>              | <input type="checkbox"/>    | <input type="checkbox"/>    |
| 3. RHENUS System | <input type="checkbox"/>    | <input type="checkbox"/>      | <input type="checkbox"/>     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>              | <input type="checkbox"/>    | <input type="checkbox"/>    |
| 4. P System      | <input type="checkbox"/>    | <input type="checkbox"/>      | <input type="checkbox"/>     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>              | <input type="checkbox"/>    | <input type="checkbox"/>    |
| 5. I System      | <input type="checkbox"/>    | <input type="checkbox"/>      | <input type="checkbox"/>     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>              | <input type="checkbox"/>    | <input type="checkbox"/>    |
| 6. MN System     | <input type="checkbox"/>    | <input type="checkbox"/>      | <input type="checkbox"/>     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>              | <input type="checkbox"/>    | <input type="checkbox"/>    |
| 7. DUFFY System  | <input type="checkbox"/>    | <input type="checkbox"/>      | <input type="checkbox"/>     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>              | <input type="checkbox"/>    | <input type="checkbox"/>    |
| 8. KELL System   | <input type="checkbox"/>    | <input type="checkbox"/>      | <input type="checkbox"/>     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>              | <input type="checkbox"/>    | <input type="checkbox"/>    |
| 9. KIDD System   | <input type="checkbox"/>    | <input type="checkbox"/>      | <input type="checkbox"/>     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>              | <input type="checkbox"/>    | <input type="checkbox"/>    |

C. For the following tests, indicate (+) those procedures that you routinely use in antibody detection and/or antibody identification in your immunohematology laboratory.

| ITEM                               | 1 REQUIRED FOR WORK PLACE |                          | 2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS |                          |                          |
|------------------------------------|---------------------------|--------------------------|---------------------------------------------|--------------------------|--------------------------|
|                                    | YES                       | NO                       | NICE TO KNOW                                | OFTEN NEEDED             | ESSENTIAL                |
| 1. Saline room temperature         | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. LISS room temperature           | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Saline 37°C                     | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Albumin 37°C                    | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. LISS 37°C                       | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Saline indirect antiglobulin    | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Albumin indirect antiglobulin   | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. LISS 37°C indirect antiglobulin | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. one stage enzyme 37°C test      | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Two stage enzyme 37°C test     | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |



D. For each item below, check (✓) the appropriate responses

| ITEM                                                                  | 1 REQUIRED FOR WORK PLACE |                       | 2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS: |                          |                          |
|-----------------------------------------------------------------------|---------------------------|-----------------------|----------------------------------------------|--------------------------|--------------------------|
|                                                                       | YES                       | NO                    | NICE TO KNOW                                 | OFTEN NEEDED             | ESSENTIAL                |
| <b>1. BLOOD GROUP SYSTEMS:</b>                                        |                           |                       |                                              |                          |                          |
| a) <u>ABO</u> : secretor testing                                      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| b) <u>LEWIS</u> : - method of detecting antigens in secretion         | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| c) <u>RHESUS</u> : - history of Rh system                             | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| - Fisher-Race nomenclature                                            | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| - Wiener nomenclature                                                 | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| - genetic basis of D <sub>i</sub>                                     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| - characteristics of anti-G                                           | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| d) <u>I</u> : characteristics of anti-HI                              | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| e) <u>P</u> : characteristics of anti-P (Donath-Landsteiner antibody) | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>2. DIRECT &amp; INDIRECT ANTIGLOBULIN TESTS:</b>                   |                           |                       |                                              |                          |                          |
| a) principles and uses                                                | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| b) quality control                                                    | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| c) performance of test                                                | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| d) interpretation of results                                          | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| e) sources of error                                                   | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| f) specificity of antiglobulin sera                                   | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| g) use of monospecific sera                                           | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| h) use of polyspecific sera                                           | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |



☐ YES ☐ NO

If YES, indicate (✓) which of the following is required to work in your laboratory.

If NO, proceed to question 7.

| ITEM                         | 1 REQUIRED FOR WORK PLACE |                          | 2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS |                          |                          |
|------------------------------|---------------------------|--------------------------|---------------------------------------------|--------------------------|--------------------------|
|                              | YES                       | NO                       | NICE TO KNOW                                | OFTEN NEEDED             | ESSENTIAL                |
| 1. phenotyping               | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. absorptions               | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. heat elutions             | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. use of 2 mercapto-ethanol | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. use of dithiothreitol     | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. titrations                | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. tests at 4°C, 18°C, 30°C  | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |

F. How well do you feel the new graduates are prepared to recognize the causes, the effects and the resolution of the following problems routinely encountered in the Immunopathology department ?

| ITEM                             | TOO MUCH PREPARATION     | PREPARATION OKAY         | NOT ENOUGH PREPARATION   | NOT PREPARED AT ALL      |
|----------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. rouleaux formation            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. panagglutinins                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. polyagglutinins               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. cold autoagglutinins          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Wharton's jelly               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. prozones                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. dosage effect                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. antigen/antibody desaturation | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. mixed field agglutination     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |



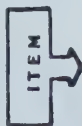


G. For each item below, indicate (✓) the appropriate responses.

| ITEM                                                | 1 REQUIRED FOR WORK PLACE |                       | 2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS: |                          |                          |
|-----------------------------------------------------|---------------------------|-----------------------|----------------------------------------------|--------------------------|--------------------------|
|                                                     | YES                       | NO                    | NICE TO KNOW                                 | OFTEN NEEDED             | ESSENTIAL                |
| 1. <u>Antibody detection and/or identification:</u> |                           |                       |                                              |                          |                          |
| a) criteria for the selection of screening cells    | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| b) criteria for the selection of panel cells        | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| c) use of cold autoabsorption                       | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| d) use of monospecific anti-IgG                     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| e) detection of alloantibodies                      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| f) specificity of autantisbodies (warm & cold)      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| g) drug induced hemolytic anemia: problems          | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. <u>Compatibility testing:</u>                    |                           |                       |                                              |                          |                          |
| a) verifying I.D. of the patient                    | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| b) verifying patient specimens                      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| c) verifying donor units                            | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| d) significance of the following tests:             |                           |                       |                                              |                          |                          |
| i) saline room temperature                          | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| ii) LISS room temperature                           | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| iii) saline 37°C                                    | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| iv) albumin 37°C                                    | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| v) LISS 37°C                                        | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| vi) saline indirect antiglobulin                    | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| vii) albumin indirect antiglobulin                  | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| viii) LISS 37°C indirect antiglobulin               | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| ix) one stage enzyme 37°C test                      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| x) two stage enzyme 37°C test                       | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| xi) enzyme antiglobulin                             | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| e) limitations of compatibility tests               | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |



H. For each item below, indicate (✓) the appropriate responses.



| ITEM                                                                                      | 1 REQUIRED FOR WORK PLACE |                       | 2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS: |                          |                          |                          |
|-------------------------------------------------------------------------------------------|---------------------------|-----------------------|----------------------------------------------|--------------------------|--------------------------|--------------------------|
|                                                                                           | YES                       | NO                    | NICE TO KNOW                                 | OFTEN NEEDED             | ESSENTIAL                |                          |
| 1. <u>Selecting donor blood:</u>                                                          |                           |                       |                                              |                          |                          |                          |
| a) in routine & emergency situations                                                      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) when recipient's specimen is not available                                             | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) when group specific blood is not available                                             | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d) N.B. of visual checking of donor units prior to issuing                                | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. High incidence antibodies: problems                                                    | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Low incidence antibodies: problems                                                     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. <u>Transfusion reactions:</u>                                                          |                           |                       |                                              |                          |                          |                          |
| a) allo-immunization: consequences                                                        | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) criteria used to differentiate urticarial, anaphylactic, febrile & hemolytic reactions | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) preventive measures taken                                                              | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d) procedure for investigation                                                            | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. <u>Hemolytic disease of the newborn:</u>                                               |                           |                       |                                              |                          |                          |                          |
| a) causes and clinical symptoms                                                           | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) investigative tests: i) prenatal                                                       | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| ii) postnatal                                                                             | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) acid elution test for detection of fetal red cells in maternal circulation             | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d) bile pigments in amniotic fluid: significance                                          | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e) constituents and use of Rh immune globulin                                             | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| f) selection of donor blood:                                                              | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| i) for exchange transfusion                                                               | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| ii) for intravascular transfusion                                                         | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |



INSTRUCTION: THIS SECTION SHOULD BE COMPLETED BY THOSE EMPLOYERS WHO HAVE A HEMATOLOGY DEPARTMENT IN THEIR LABORATORY. IF YOU DO NOT HAVE A HEMATOLOGY DEPARTMENT IN YOUR LABORATORY, PROCEED TO SECTION 5 →

A. For each method below, indicate (✓) what a new graduate needs to know to work effectively in Hematology.

[illegible]



B. For the following peripheral blood cells and their precursors in the bone marrow, indicate (✓) what the NEW graduate needs to know for the work place.

ITEM

1. Peripheral blood: a) erythrocytes

b) leukocytes: mature granulocytes  
lymphocytes  
monocytes

c) platelets

2. Bone marrow precursors: a) blast cells

b) RBC: pronormoblast

basophilic normoblast

polychromatic normoblast

orthochromatic normoblast

c) WBC: promyelocyte

myelocyte

metamyelocyte

band cell

immature monocyte,  
and lymphocyte

d) megakaryocyte

REQUIRED IN THE WORK PLACE

NO

✓

✓

✓

✓

✓

✓

✓

✓

✓

✓

✓

✓

✓

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NICE TO KNOW

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✓

C. For each staining method below, indicate (✓) the appropriate response.

STAINS

1 REQUIRED FOR WORK PLACE

YES

NO

1. Romanowsky stains: Wright's

Giemsa

2. Perl's Prussian blue reaction

3. Supravital stain (reticulocytes)

4. Heinz body stain

2 IF YES TO 1. REQUIREMENT IN WORK PLACE IS:

PROCEDURE

PREPARATION OF REAGENTS

PRINCIPLE OF STAIN

✓

✓

✓

✓

✓

✓

✓

✓

✓

✓

✓

✓

✓

✓

✓

✓

✓

✓

✓

✓





D. For each instrument below, indicate (✓) what a new graduate should know for the work place.

| INSTRUMENTS                    | PRINCIPLE OF OPERATION   | APPLICATION & USE        | CALIBRATION              | ROUTINE MAINTENANCE      |
|--------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. Electronic cell counters    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Hemoglobinometers           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Automatic slide stainers    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Coagulation timers          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Microhematocrit centrifuges | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

E. For each item below, indicate (✓) the appropriate response.

| ITEM                                        | REQUIRED IN THE WORK PLACE |                          |                          |                          |
|---------------------------------------------|----------------------------|--------------------------|--------------------------|--------------------------|
|                                             | NO                         | NICE TO KNOW             | OFTEN NEEDED             | ESSENTIAL                |
| <b>HEMOPOIESIS</b>                          |                            |                          |                          |                          |
| 1. Role of bone marrow                      | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Role of liver                            | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Role of spleen                           | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Role of lymph nodes                      | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Sequential development of erythrocytes   | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Sequential development of leukocytes     | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Sequential development of megakaryocytes | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Dietary requirements                     | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Regulatory hormones                      | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Life span of erythrocytes               | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. Life span of leukocytes                 | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. Life span of platelets                  | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. Hemoglobin degradation                  | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. Hemoglobin excretion                    | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. Platelet role in hemostasis             | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 16. Erythrocyte role in gas transport       | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 17. Leukocyte role in phagocytosis          | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |







H. With regard to abnormal blood cell morphology, indicate (✓) all that is required to work effectively in the Hematology department.

| ABNORMAL BLOOD CELL<br>MORPHOLOGY   | REQUIREMENT IN THE WORK PLACE |                          |                          |
|-------------------------------------|-------------------------------|--------------------------|--------------------------|
|                                     | NOT REQUIRED                  | APPEARANCE               | SIGNIFICANCE             |
| 1. Hypochromia                      | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Polychromasia                    | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Anisocytosis                     | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Poikilocytosis                   | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Microcytosis                     | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Macrocytosis                     | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Spherocytosis                    | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Ovalocytosis                     | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Burr cells                       | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Schistocytes                    | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. Target cells                    | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. Sickle cells                    | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. Crenated cells                  | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. Malarial parasites              | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. Stomatocytes                    | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 16. Acanthocytes                    | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 17. Red cell inclusions             | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 18. White cell inclusions           | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 19. Auer rods                       | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 20. Hypersegmentation               | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 21. Pelger-Huet anomaly             | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 22. Leukopenia/Leukocytosis         | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 23. Thrombocytopenia/Thrombocytosis | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 24. Atypical Lymphocytes            | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 25. Smudge cells                    | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |



## SECTION 5: CLINICAL MICROBIOLOGY

INSTRUCTION: THIS SECTION IS TO BE COMPLETED BY THOSE EMPLOYERS WHO HAVE A MICROBIOLOGY DEPARTMENT IN THEIR LABORATORY. IF YOU DO NOT HAVE A MICROBIOLOGY DEPARTMENT IN YOUR LABORATORY, PROCEED TO SECTION 6 →

A. For each item below, check (✓) the appropriate responses.

| ITEM                                      | 1 REQUIRED FOR WORK PLACE |                       | 2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS |                          |                          |
|-------------------------------------------|---------------------------|-----------------------|---------------------------------------------|--------------------------|--------------------------|
|                                           | YES                       | NO                    | NICE TO KNOW                                | OFTEN NEEDED             | ESSENTIAL                |
| 1. Characteristics of bacteria:           |                           |                       |                                             |                          |                          |
| a) nuclear structure                      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| b) cytoplasmic structure                  | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| c) cell wall composition                  | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| d) flagella                               | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| e) method: nuclear division               | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| f) relationship with plant/animal kingdom | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| g) bacterial growth curve                 | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| h) morphology of bacterial colonies       | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Anatomy of eubacterial cell            | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Culture media: prep. & storage         | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| a) blood agar plates                      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| b) tube slanted media                     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| c) medium with heat sensitive ingredient  | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| d) checking/adjusting of pH               | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| e) criteria for pH 7 Eh indicators        | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| f) storage of dehydrated/prepared media   | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Function & ingredients of:             | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| a) blood agar                             | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| b) fluid media for primary culture        | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| c) differential media                     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| d) selective media                        | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| e) transport media                        | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |





- 2 -

8. For the following differential procedures, indicate (✓) what is needed to work effectively in clinical microbiology.

| DIFFERENTIAL PROCEDURES              | PRINCIPLE                | APPLICATION              | INTERPRETATION           | PERFORMANCE OF TEST      | USE OF CONTROLS          |
|--------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. Catalase test                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Slide/tube coagulase test         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Hemolysis on blood agar plates    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Bacitracin susceptibility         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Optochin sensitivity              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Bile solubility                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Esculin hydrolysis                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Growth on 40% bile agar           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Growth in 6.5% NaCl broth         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Oxidase test                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. Carbohydrate fermentation        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. Triple sugar iron (TSI) agar     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. Methylene red (MR) test          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. Voges-Proskauer test             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. RPG test                         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 16. Indole production                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 17. Urease test                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 18. Simmons' citrate test            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 19. Decarboxylase tests              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 20. Phenylalanine deaminase test     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 21. Nitrate/nitrite reduction        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 22. Gelatinase test                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 23. Pigment production               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 24. $H_2S$ production in TSI agar    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 25. Motility                         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 26. X & V factor growth requirements | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |



- 2 -

8. For the following differential procedures, indicate (✓) what is needed to work effectively in clinical microbiology.

| DIFFERENTIAL PROCEDURES              | PRINCIPLE                | APPLICATION              | INTERPRETATION           | PERFORMANCE OF TEST      | USE OF CONTROLS          |
|--------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. Catalase test                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Slide/tube coagulase test         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Hemolysis on blood agar plates    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Bacitracin susceptibility         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Optochin sensitivity              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Bile solubility                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Esculin hydrolysis                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Growth on 40% bile agar           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Growth in 6.5% NaCl broth         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Oxidase test                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. Carbohydrate fermentation        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. Triple sugar iron (TSI) agar     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. Methylene red (MR) test          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. Voges-Proskauer test             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. RPG test                         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 16. Indole production                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 17. Urease test                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 18. Simmons' citrate test            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 19. Decarboxylase tests              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 20. Phenylalanine deaminase test     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 21. Nitrate/nitrite reduction        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 22. Gelatinase test                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 23. Pigment production               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 24. $H_2S$ production in TSI agar    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 25. Motility                         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 26. X & V factor growth requirements | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |



[illegible]



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E. For each clinical specimen below, check (✓) those items required for proper examination of specimen in the work place.

| CLINICAL SPECIMENS          | SAFETY PRECAUTIONS       | SUITABILITY OF SPECIMEN  | MACROSCOPIC EXAMINATION  | MICROSCOPIC EXAMINATION  | APPROPRIATE MEDIA        | INOCULATION OF PRIMARY ISOLATION MEDIA | TESTS FOR IDENTIFICATION | NEED FOR PRELIMINARY REPORT |
|-----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|----------------------------------------|--------------------------|-----------------------------|
| 1. Blood culture            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 2. CSF                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 3. Effusions                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 4. Biopsied tissue          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 5. Surgical wounds          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 6. Urine                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 7. Feces                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 8. Sputum                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 9. Swab from ear            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 10. Swab from nose          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 11. Swab from throat        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 12. Swab from nasopharynx   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 13. Swab from skin          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |
| 14. Swab from genital tract | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>               | <input type="checkbox"/> | <input type="checkbox"/>    |

F. Does your laboratory routinely do mycology? Yes ☐ No ☐

If YES, indicate (✓) which of the following is required to work effectively in your laboratory.

If NO, proceed to question G →

| YEAST-LIKE FUNGI                     | GROWTH REQUIREMENTS      | NATURAL HABITAT          | SOURCES OF INFECTION     | PATHOGENICITY            | DIFFERENTIATION OF ORGANISM |
|--------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-----------------------------|
| 1. <i>Candida albicans</i>           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>    |
| 2. Other <i>Candida</i> species      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>    |
| 3. <i>Cryptococcus neoformans</i>    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>    |
| 4. Other <i>cryptococcus</i> species | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>    |
| 5. <i>Torulopsis glabrata</i>        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>    |





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G. For each item below, check (✓) the appropriate responses.

| ITEM                                             | 1 REQUIRED FOR WORK PLACE |                       | 2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS: |                          |                          |
|--------------------------------------------------|---------------------------|-----------------------|----------------------------------------------|--------------------------|--------------------------|
|                                                  | YES                       | NO                    | NICE TO KNOW                                 | OFTEN NEEDED             | ESSENTIAL                |
| 1. <u>Quality control:</u> sterility testing     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. <u>Culturing:</u>                             |                           |                       |                                              |                          |                          |
| a) Streaking petri plate media                   | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| b) Transferring bacteria by wire loop/needle     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| c) Accurate pipetting of bacterial suspensions   | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| d) Inoculation of broth cultures                 | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| e) Selective cultivation of micro-organisms      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| f) Viable counts using loop technique            | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| g) Use of dipslides                              | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| h) Anaerobic culturing using anaerobic jar       | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| i) Use of En indicators                          | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| j) Culturing in CO <sub>2</sub> atmosphere       | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| k) Preservation of stock cultures                | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Blood cultures: a) collection of specimens    | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| b) subculturing                                  | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| c) incubation periods                            | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. <u>Cerebrospinal fluid:</u>                   |                           |                       |                                              |                          |                          |
| a) significance of presence of WBC cells         | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. <u>Respiratory Tract:</u>                     |                           |                       |                                              |                          |                          |
| a) technique for liquefaction of sputum          | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| b) microscopic appearance of Vincent's infection | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. <u>Microscopic examination</u>                |                           |                       |                                              |                          |                          |
| a) wet preparations for motility                 | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| b) use of Gram stain                             | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |



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H. For each item below, check (✓) the appropriate responses.

| ITEM                                                           | 1 REQUIRED FOR WORK PLACE |                       | 2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS: |                          |                          |
|----------------------------------------------------------------|---------------------------|-----------------------|----------------------------------------------|--------------------------|--------------------------|
|                                                                | YES                       | NO                    | NICE TO KNOW                                 | OFTEN NEEDED             | ESSENTIAL                |
| <u>Antimicrobial susceptibility testing</u>                    |                           |                       |                                              |                          |                          |
| 1. Bacteriostatic activity                                     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Bactericidal activity                                       | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Antimicrobial spectrum of antibodies                        | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. <u>Use of Kirby-Bauer technique:</u>                        | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| a) prep. of MacFarland BaSO <sub>4</sub> standard              | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| b) prep./standardization of inoculum                           | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| c) use of Mueller-Hinton agar                                  | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| d) preparation/inoculation of agar plates                      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| e) reading/interpretation of results                           | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| f) storage of discs                                            | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| g) limitations of the technique                                | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Detection of B-lactamase production                         | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Principle of the Schlichter test (serum bactericidal level) | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| <u>Parasitology</u>                                            |                           |                       |                                              |                          |                          |
| a) use of Scotch (R) tape preparations                         | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| b) morphology of pinworm eggs                                  | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| c) wet mounts for Trichomonas vaginalis                        | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| <u>Active immunization:</u>                                    |                           |                       |                                              |                          |                          |
| a) use of live attenuated vaccines                             | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| b) use of killed vaccines                                      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| c) use of toxoids                                              | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| <u>Passive immunization</u>                                    |                           |                       |                                              |                          |                          |
| a) use of antitoxins                                           | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |



| SEROLOGICAL METHODS                                            | PRINCIPLE                | APPLICATION              | INTERPRETATION           | PERFORMANCE OF TEST      | USE OF CONTROLS          |
|----------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. Slide agglutination tests<br>(for enteropathogenic E. Coli) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Lancefield grouping                                         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Nagler reaction                                             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Elek test                                                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

[illegible]



INSTRUCTION: THIS SECTION IS TO BE COMPLETED BY THOSE EMPLOYERS WHO HAVE A CHEMISTRY DEPARTMENT IN THEIR LABORATORY. IF YOU DO NOT HAVE A CHEMISTRY DEPARTMENT IN YOUR LABORATORY, PROCEED TO SECTION 7 →

A. For each item below, indicate (✓) the appropriate responses.

| ITEM                                                        | 1 REQUIRED FOR WORK PLACE |                       | 2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS: |                          |                          |                          |
|-------------------------------------------------------------|---------------------------|-----------------------|----------------------------------------------|--------------------------|--------------------------|--------------------------|
|                                                             | YES                       | NO                    | NICE TO KNOW                                 | OFTEN NEEDED             | ESSENTIAL                |                          |
| 1. Carbohydrates:                                           |                           |                       |                                              |                          |                          |                          |
| a) differentiate between mono-, di- and poly- saccharides   | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) reducing vs non-reducing sugar                           | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) carbohydrate metabolism                                  | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d) oral glucose tolerance test                              | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e) 2 hour p.c. blood sugar                                  | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Lipids: a) solubility characteristics                    | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) simple vs compound lipid                                 | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) structure of cholesterol                                 | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d) structure of triglycerides                               | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e) fatty acid oxidation                                     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Proteins: describe ...                                   |                           |                       |                                              |                          |                          |                          |
| a) primary structure                                        | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) secondary structure                                      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) tertiary structure                                       | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d) amphoteric properties of proteins                        | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e) five major protein groups (separated by electrophoresis) | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Non-protein Nitrogenous Substances:                      |                           |                       |                                              |                          |                          |                          |
| a) formation/excretion of: a) urea                          | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) creatinine                                               | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) uric acid                                                | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |





B. For each item below, indicate (✓) the appropriate responses.

| ITEM                                       | 1 REQUIRED FOR WORK PLACE |                       | 2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS: |                          |                          |                          |
|--------------------------------------------|---------------------------|-----------------------|----------------------------------------------|--------------------------|--------------------------|--------------------------|
|                                            | YES                       | NO                    | NICE TO KNOW                                 | OFTEN NEEDED             | ESSENTIAL                |                          |
| 1. Acid-base & Electrolytes:               |                           |                       |                                              |                          |                          |                          |
| a) control of blood pH by buffer systems   | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) regulation of pH by renal system        | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) regulation of pH by respiratory system  | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d) use of Henderson-Hasselbalch equation   | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e) hemoglobin as an oxygen carrier         | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| f) anions and cations in blood             | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| g) metabolism of electrolytes              | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| h) osmolality                              | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Enzymes:                                |                           |                       |                                              |                          |                          |                          |
| a) general structure                       | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) catalytic properties                    | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) classification                          | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d) enzyme activity: what effects?          | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e) measurements: endpoint vs kinetic types | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| f) define isoenzyme                        | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Ligand Assay:                           |                           |                       |                                              |                          |                          |                          |
| a) principle                               | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) basic concepts of:                      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| - CFB                                      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| - FIA                                      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| - EIA                                      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Liver Function:                         |                           |                       |                                              |                          |                          |                          |
| a) role of liver in:                       | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| - carbohydrate metabolism                  | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| - protein metabolism                       | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| - lipid metabolism                         | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| - detoxification                           | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| - bilirubin metabolism                     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |







D. For each item below, indicate (✓) the appropriate responses.



| ITEM                                          | 1 REQUIRED FOR WORK PLACE |    | 2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS |              |           |
|-----------------------------------------------|---------------------------|----|---------------------------------------------|--------------|-----------|
|                                               | YES                       | NO | NICE TO KNOW                                | OFTEN NEEDED | ESSENTIAL |
| 1. Renal function: a) role of the kidney in:  |                           |    |                                             |              |           |
| - excretion of waste products                 |                           |    |                                             |              |           |
| - osmoregulation                              |                           |    |                                             |              |           |
| - acid-base/electrolyte regulation            |                           |    |                                             |              |           |
| 2. Evaluation of renal function by:           |                           |    |                                             |              |           |
| - osmolality                                  |                           |    |                                             |              |           |
| - specific gravity                            |                           |    |                                             |              |           |
| - creatinine clearance                        |                           |    |                                             |              |           |
| 3. Pregnancy test: a) principle               |                           |    |                                             |              |           |
| b) limitations                                |                           |    |                                             |              |           |
| c) sources of error                           |                           |    |                                             |              |           |
| 4. Statistics: a) terminology                 |                           |    |                                             |              |           |
| b) Gaussian distribution                      |                           |    |                                             |              |           |
| c) non-Gaussian distribution                  |                           |    |                                             |              |           |
| 5. Reference interval (normal values):        |                           |    |                                             |              |           |
| a) calculation                                |                           |    |                                             |              |           |
| b) need to establish for lab                  |                           |    |                                             |              |           |
| c) effects of physiological variables         |                           |    |                                             |              |           |
| 6. Laboratory Application of quality control: |                           |    |                                             |              |           |
| a) primary vs secondary standards             |                           |    |                                             |              |           |
| b) standards vs controls                      |                           |    |                                             |              |           |
| c) commercial controls vs in-house pools      |                           |    |                                             |              |           |
| d) prep. & use: - stock standards             |                           |    |                                             |              |           |
| - working standards                           |                           |    |                                             |              |           |
| e) for methods: - specificity                 |                           |    |                                             |              |           |
| - sensitivity                                 |                           |    |                                             |              |           |
| - allowable limits of error                   |                           |    |                                             |              |           |
| f) prep. of quality control charts            |                           |    |                                             |              |           |



E. For each instrument below, indicate (✓) all that is required by a new graduate to work effectively in clinical chemistry.

| INSTRUMENTS                            | REQUIREMENT IN THE WORK PLACE |                          |                          |
|----------------------------------------|-------------------------------|--------------------------|--------------------------|
|                                        | NOT REQUIRED                  | PRINCIPLE                | APPLICATION              |
| 1. Continuous flow analyzer            | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Centrifugal analyzer                | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Discrete analyzer                   | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Fluorometer                         | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Atomic absorption spectrophotometer | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Flame photometer                    | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Densitometer                        | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Osmometer                           | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Chloridometer                       | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Nephelometer                       | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. Refractometer                      | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |

F. For each item below, indicate (✓) the depth of knowledge of spectrophotometry required in the work place.

| ITEM                                                                                                                                                                                                                                                       | REQUIREMENT IN THE WORK PLACE |                          |                          |                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|--------------------------|--------------------------|--------------------------|
|                                                                                                                                                                                                                                                            | NO                            | NICE TO KNOW             | OFTEN NEEDED             | ESSENTIAL                |
| 1. Monochromators: principle, application and limitations                                                                                                                                                                                                  | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Light sources: uses                                                                                                                                                                                                                                     | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Cuvettes: types                                                                                                                                                                                                                                         | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Photodetectors: principle/uses of: <ul style="list-style-type: none"> <li>a) barrier layer cell <input type="checkbox"/></li> <li>b) photoconductive tube <input type="checkbox"/></li> <li>c) photomultiplier tube <input type="checkbox"/></li> </ul> | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Function of: <ul style="list-style-type: none"> <li>a) galvanometer <input type="checkbox"/></li> <li>b) potentiometer <input type="checkbox"/></li> </ul>                                                                                              | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Glancing wavelength calibration                                                                                                                                                                                                                         | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |





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G. For each specimen below, indicate (✓) the tests and methods that a new graduate needs to know in the work place.

| SPECIMEN                                          | REQUIREMENT IN THE WORK PLACE |                          |                          |
|---------------------------------------------------|-------------------------------|--------------------------|--------------------------|
|                                                   | NOT REQUIRED                  | PERFORMANCE OF THE TEST  | SIGNIFICANCE             |
| 1. <u>Urine:</u> a) <u>routine analysis:</u>      |                               |                          |                          |
| - color                                           | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| - pH                                              | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| - specific gravity                                | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| - protein                                         | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| - glucose                                         | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| - bile pigments                                   | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| - blood                                           | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| - ketones                                         | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| - microscopic examination                         | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. <u>Urine:</u> b) <u>special tests:</u>         |                               |                          |                          |
| - urobilinogen                                    | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| - porphobilinogen                                 | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| - Benedict-Jones protein                          | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| - for cystine                                     | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| - phenylpyruvic acid                              | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. <u>Feces:</u> a) <u>macroscopic appearance</u> |                               |                          |                          |
| b) tests for: - occult blood                      | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| - fecal fat                                       | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| - bile/urobilinogen                               | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. <u>CSF:</u> a) estimation of a) protein        | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| b) glucose                                        | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| b) clin. significance of results                  | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. <u>Gastric Analysis:</u>                       |                               |                          |                          |
| a) principle of tube method                       | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |
| b) method to determine acidity                    | <input type="checkbox"/>      | <input type="checkbox"/> | <input type="checkbox"/> |



# SECTION 7: HISTOTECHNOLOGY

INSTRUCTION: THIS SECTION SHOULD BE COMPLETED BY THOSE EMPLOYERS WHO HAVE A HISTOTECHNOLOGY DEPARTMENT IN THEIR LABORATORY. IF YOU DO NOT HAVE A HISTOTECHNOLOGY DEPARTMENT IN YOUR LABORATORY, OMIT THIS SECTION.

A. For each item below, check (✓) the appropriate responses.

| ITEM                                                                          | 1 REQUIRED FOR WORK PLACE |                       | 2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS: |                          |                          |
|-------------------------------------------------------------------------------|---------------------------|-----------------------|----------------------------------------------|--------------------------|--------------------------|
|                                                                               | YES                       | NO                    | NICE TO KNOW                                 | OFTEN NEEDED             | ESSENTIAL                |
| 1. <u>Normal histology of primary tissues:</u>                                |                           |                       |                                              |                          |                          |
| a) epithelium                                                                 | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| b) connective tissue                                                          | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| c) muscle tissue                                                              | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| d) nervous tissue                                                             | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. <u>Fixation:</u>                                                           |                           |                       |                                              |                          |                          |
| a) purpose                                                                    | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| b) effect on tissue components                                                | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| c) effects of autolysis & putrefaction                                        | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| d) effect of heat, vacuum & agitation                                         | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. <u>Infiltration with paraffin:</u>                                         |                           |                       |                                              |                          |                          |
| a) characteristics of commercial paraffin                                     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| b) use of vacuum infiltration                                                 | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. <u>Processing equipment: operation, advantages &amp; disadvantages of:</u> |                           |                       |                                              |                          |                          |
| a) Autotechnicon (B) type                                                     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| b) Fluid exchange                                                             | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. <u>Embedding:</u>                                                          |                           |                       |                                              |                          |                          |
| a) use of embedding equipment                                                 | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| b) practical orientation of tissue                                            | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| c) sources of error                                                           | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| d) corrective procedures                                                      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |



B. For each fixative agent and compound fixative, indicate (✓) what a new graduate needs to know to function effectively in Histotechnology.

| ITEM                    | THEORY                   | USES                     | ADVANTAGES               | DISADVANTAGES            |
|-------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. Formaldehyde         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Mercuric chloride    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Potassium dichromate | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Picric Acid          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Osmium tetroxide     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Ethanol              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. N.B.F.S.             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Zenker's             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Helly's              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Bouin's             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

C. In decalcification, indicate (✓) what a new graduate needs to know to function effectively in Histotechnology.

| ITEM                   | PRINCIPLE                | USE                      | ADVANTAGES               | DISADVANTAGES            |
|------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. Formic Acid         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Nitric Acid         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. EDTA                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Tests for endpoint: |                          |                          |                          |                          |
| a) chemical            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) radiological        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) physical probing    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |



D. For each item below, indicate (/) the appropriate responses.

| ITEM                                                       | 1 REQUIRED FOR WORK PLACE |                       | 2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS |                          |                          |
|------------------------------------------------------------|---------------------------|-----------------------|---------------------------------------------|--------------------------|--------------------------|
|                                                            | YES                       | NO                    | NICE TO KNOW                                | OFTEN NEEDED             | ESSENTIAL                |
| 1. <u>Microtome knives:</u>                                |                           |                       |                                             |                          |                          |
| a) how many degrees is: i) wedge angle                     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| ii) clearance angle                                        | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| b) definition of cutting facet                             | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. <u>Automatic knife sharpeners:</u>                      |                           |                       |                                             |                          |                          |
| a) routine maintenance                                     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| b) relevance of abrasive particle size to:                 |                           |                       |                                             |                          |                          |
| i) honing (coarse)                                         | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| ii) stropping (fine)                                       | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. <u>Rotary microtome:</u>                                |                           |                       |                                             |                          |                          |
| a) operation                                               | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| b) importance of clearance angle                           | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| c) routine maintenance                                     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. <u>Dye chemistry: understanding . . .</u>               |                           |                       |                                             |                          |                          |
| a) <u>resonance systems</u>                                | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| b) <u>dye structure terminology:</u>                       |                           |                       |                                             |                          |                          |
| i) chromophore                                             | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| ii) chromogen                                              | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| iii) auxochrome                                            | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| c) acid, base & neutral dyes and their staining properties | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| d) physical theory of staining                             | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| e) chemical theory of staining:                            |                           |                       |                                             |                          |                          |
| i) salt linkage                                            | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| ii) hydrogen bond                                          | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| iii) metachromasia                                         | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| iv) metallic impregnation                                  | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |





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E. For each item below, check (✓) the appropriate responses.

| ITEM                                                                                    | 1 REQUIRED FOR WORK PLACE |                       | 2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS |                          |                          |
|-----------------------------------------------------------------------------------------|---------------------------|-----------------------|---------------------------------------------|--------------------------|--------------------------|
|                                                                                         | YES                       | NO                    | NICE TO KNOW                                | OFTEN NEEDED             | ESSENTIAL                |
| <b>1. Paraffin sectioning:</b>                                                          |                           |                       |                                             |                          |                          |
| a) effect of block temp. on sections                                                    | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| b) effect of cutting speed on sections                                                  | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| c) common cutting faults: recognition, causes and remedies                              | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| d) floating out sections: purpose                                                       | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| e) advantages/disadvantages of adding section adhesives to: i) water bath<br>ii) slides | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| f) serial sectioning: use & practice                                                    | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| g) step sectioning: use & practice                                                      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>2. Staining practices:</b>                                                           |                           |                       |                                             |                          |                          |
| a) proper storage of dyes                                                               | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| b) relevance of color index numbers                                                     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| c) principle & application of:                                                          |                           |                       |                                             |                          |                          |
| i) progressive/regressive staining                                                      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| ii) acid differentiation                                                                | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| iii) mordant differentiation                                                            | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| iv) decolorization                                                                      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| v) direct staining                                                                      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| vi) indirect staining                                                                   | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| vii) use of accentuators                                                                | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| viii) argyrophil reaction                                                               | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |
| ix) argentaffin reaction                                                                | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                    | <input type="checkbox"/> | <input type="checkbox"/> |



F. For each item below, indicate (✓) the appropriate responses.

| ITEM                                          | 1 REQUIRED FOR WORK PLACE |                       | 2 IF YES TO 1, REQUIREMENT IN WORK PLACE IS: |                          |                          |
|-----------------------------------------------|---------------------------|-----------------------|----------------------------------------------|--------------------------|--------------------------|
|                                               | YES                       | NO                    | NICE TO KNOW                                 | OFTEN NEEDED             | ESSENTIAL                |
| 1. <u>Cryostat:</u>                           |                           |                       |                                              |                          |                          |
| a) use of anti-roll device                    | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| b) disinfection                               | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| c) routine maintenance                        | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| d) procedure and practice for:                |                           |                       |                                              |                          |                          |
| i) cutting unfixed tissue                     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| ii) cutting fixed tissue                      | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| e) cause & appearance of ice crystal artifact | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| f) rapid H & E stain: procedure               | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| g) polychrome methylene blue stain: procedure | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| h) use of cryostat sections for:              |                           |                       |                                              |                          |                          |
| i) lipid stains                               | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| ii) demonstrating enzymes                     | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. <u>De waxing paraffin sections</u>         | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. <u>Hydrating paraffin sections</u>         | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. <u>Removal of fixation artifacts</u>       | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. <u>Celloidin coating sections</u>          | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. <u>Coverslipping using:</u>                |                           |                       |                                              |                          |                          |
| a) resinous mountants                         | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| b) aqueous mountants                          | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. <u>Refractive index of mounting media</u>  | <input type="radio"/>     | <input type="radio"/> | <input type="checkbox"/>                     | <input type="checkbox"/> | <input type="checkbox"/> |



G. For each specific staining method below, indicate (✓) what a new graduate needs to know to work effectively in Histotechnology.

| ITEM                                   | THEORY                   | PREPARATION OF REAGENTS  | PRACTISE                 | EVALUATION OF RESULTS    | CORRECTIVE ACTION        | CHOOSING CONTROL TISSUE  | SAFETY PRECAUTIONS       |
|----------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. Hematoxylin & Eosin                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Masson trichrome                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Weigert van Gieson                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Silver impregnation for reticulin   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. P.A.S. (Periodic Acid Schiff)       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. P.A.S. with diastase control        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Perls' Prussian Blue                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Argentaffin method for melanin      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Modified Gram stain                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Ziehl-Neelsen                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. Gomori's methenamine silver        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. Oil Red O                          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. Luxol fast blue/cresyl echt violet | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

H. In paraffin processing, indicate (✓) what the new graduate needs to know regarding each dehydration agent and clearing agent.

| ITEM                          | USES                     | ADVANTAGES               | DISADVANTAGES            | CORRECTIVE PROCEDURE     |
|-------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. <u>DEHYDRATION AGENTS:</u> |                          |                          |                          |                          |
| a) ethanol                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) isopropanol                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) acetone                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. <u>CLEARING AGENTS:</u>    |                          |                          |                          |                          |
| a) xylene                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) toluene                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c) chloroform                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |



APPENDIX G

R.T. CERTIFICATION EXAMINATION RESULTS

1979-1984





CANADIAN SOCIETY OF LABORATORY TECHNOLOGISTS  
R.T. INITIAL CERTIFICATION EXAMINATION RESULTS  
SUCCESSFUL CANDIDATES

| YEAR | JUNE EXAMINATION |        | OCTOBER EXAMINATION |        | TOTAL/YEAR |        |
|------|------------------|--------|---------------------|--------|------------|--------|
|      | No.              | % Pass | No.                 | % Pass | No.        | % Pass |
| 1979 | 839              | 92.6%  | 221                 | 94.7%  | 1060       | 93.7%  |
| 1980 | 728              | 87.5%  | 218                 | 96.0%  | 946        | 91.8%  |
| 1981 | 680              | 92.3%  | 198                 | 84.6%  | 878        | 88.5%  |
| 1982 | 646              | 93.1%  | 192                 | 94.6%  | 838        | 93.9%  |
| 1983 | 602              | 90.0%  | 196                 | 95.6%  | 798        | 92.8%  |
| 1984 | 702              | 89.6%  | 206                 | 94.2%  | 908        | 91.9%  |





















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